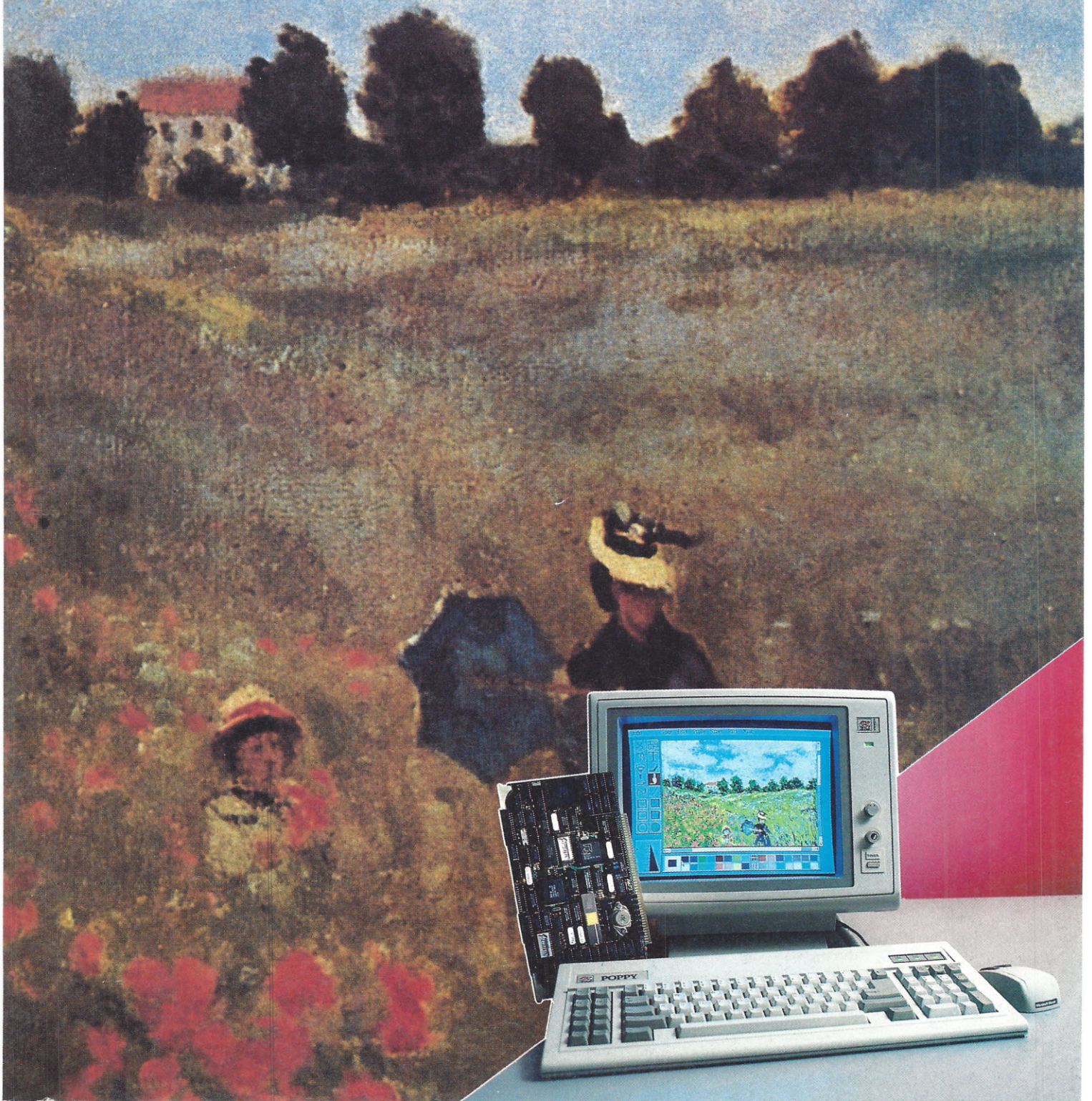


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S-100 journal



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Editor and Designer
Jay Vilhena

Associate Editor
Robert Petersen

Technical Editor
Don Pannell

Circulation
Linda Vilhena

Advertising
Jay Vilhena

Production Assistants
John Petersen
Jonathan Swann

Contributing Artists
A. Pereira
G. N. Pereira

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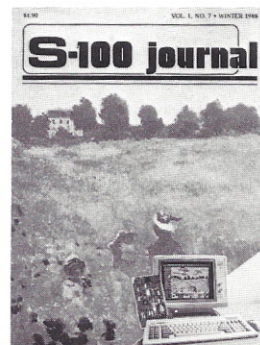
Monitor Screen:

Poppy Field by PoppyII

S-100 Board:

PoppyII by Charter Information

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PARALLEL MULTIPROCESSING

CPU speed has caught the most attention when it comes to increasing performance of microcomputers. It is traditionally assumed that the central processor has to work like a Clydesdale and get the greatest amount of work done in the shortest possible time. However, as you can see by the Budweiser draft team, and as any production manager will tell you, you can also increase the amount of work done per unit time by increasing the number of people, or horses, or CPUs doing the job.

High-performance systems such as the S-100 bus have built-in capabilities to increase the number of CPUs operating in the machine, so that the actual speed of a running multiprocessor S-100 system is more like several hundred MHz rather than the nominal 10 or 20 MHz of the main processor unit.

The multiprocessor capability of the S-100 bus has been there for years, but its utilization has been limited. Nevertheless, systems with as many as fifty CPUs have been integrated, and today a multitude of business and scientific applications depend on these multiprocessor machines for day-to-day operation. With the multitasking capabilities of newer operating systems like Concurrent DOS, there is a renewed interest in secondary parallel processors that take up

most of the load of the main CPU and therefore can increase performance many times over.

Secondary processors based on the 80286 and 80386 CPUs and which perform "main processing" are becoming available, but also of interest are intelligent peripheral boards that take over mundane tasks formerly dependent on the master CPU for execution. An excellent example is Macrotech's ADIT which manages multiple serial ports, but even less exotic boards, such as CCT's Printer-facer 1, can dramatically increase system performance by relieving the CPU of ordinary port handshaking.

We see the realization of the multiprocessor potential of the S-100 bus as even more important than the approval of a 32-bit standard, and as one of the forces that will help keep the S-100 bus as a viable solution in multiuser, multiprocessor environments for years to come. If the present multiprocessor trend continues, the future could look very bright indeed for S-100 microcomputers. Editorially, we will keep you informed as much as possible of the progresses made in this area both now and in the future.

For starters, this issue has been dedicated to multiprocessing. In the 696 *BUS* column, Don Pannell reviews the history of S-100 multiprocessing from the

days of the alternate-tasking dual-CPU boards, to today's coprocessors. In *Multiuser OS*, Fred Davis introduces FlexOS, a brand-new operating system from Digital Research which, once implemented, should provide an ideal environment for multiple CPU boards in an S-100 system.

In this issue, I also review the PoppyII, our cover feature, which is essentially another way of providing parallel multiprocessing on the S-100 bus. Regardless of what the master CPU might be, a theoretically unlimited number of PoppyIIs can be added to a system. This permits, in the tradition of TurboDOS, a large number of additional users in the system without any decline in performance for the already existing users. Of course the PoppyII is also particularly important because it offers virtually complete IBM-PC compatibility with full EGA graphics.

Another feature article, by Fred Davis, describes what coprocessing satellite CPU boards, operating in parallel with each other and the host CPU, can do to performance when they share the multiple tasks executing in a Concurrent DOS environment. As an example, the author takes a look at the Vision GPS-286, an 80286-based coprocessor board with 1 Megabyte of on-board memory.

Jay Vilhena

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Software drivers available for CPM 80, MS-DOS, ZDOS, TurboDOS, and VALDOCS 2.

READER SURVEY RESULTS

As most of you already know, this is the last *S-100 Journal*. The next issue will come out as *Supermicro* and will cover VMEbus and Multibus in addition to the S-100 bus. This is the last chance that I have to address a nearly-100% S-100 readership and therefore an appropriate time to discuss the results of a reader survey that we sent out recently. The survey was sent to one in every four subscribers.

The discussion that follows should also answer many of the questions on the letters that I have been receiving this quarter. I normally answer directly many of the letters that I get from you, but because we have been making an extra effort to come out on schedule with this issue plus the extra time in making the transition to *Supermicro*, I have not been able to answer any letters since the last issue (my apologies!), although I did read them all.

The big question on the survey, or at least what most readers perceived as the big question, was whether we should add VMEbus and Multibus coverage. Over 60% of you responded that you would *welcome* the VME and Multibus coverage. About 4% were definitely opposed, and the balance either had no opinion or did not particularly welcome the extra coverage but did not find it an objection to continue reading the Journal. Since the large majority of you are with us, we feel very encouraged in pursuing the new direction. This, we think, will insure not only the growth of our magazine but also that of the S-100 bus. The survey results indicate that between 97% and 100% of you are S-100 users or vendors which shows that our present format is attracting very few new 'converts' to the S-100 community. More users and

OEMs are a must if we want to see more variety of boards at better prices.

We are pleased to hear that most of you think well of *S-100 Journal*. In fact, on a scale of 1 to 4 rating several aspects of *S-100 Journal*, 84% of the answers fell on the 3 and 4 categories.

Probably the most significant, although not surprising, result obtained from the survey is that S-100 users are highly polarized. 1. On one hand, there are those of you who are involved with more sophisticated S-100 systems for business, scientific, military, process control, manufacturing, and other professional applications. Your systems are typically multiuser and/or multitasking, although single-user systems also rated very high in this category. This group also includes OEMs and VARs who integrate and sell those systems, and software developers. You comprise 61% of our readership with the following breakdown: Business, scientific, or military use, 36%; Programmer or consultant, 15%; OEM/VAR/Integrator/Dealer, 10%. 2. On the other hand, there are those of you who are hobbyists and/or home users. You comprise 39% of our readership. Your group tends to have CP/M-based (or related, except for Z-100 people who have MS-DOS) single-user systems, usually without multitasking. There is some tendency in this group to identify the S-100 with CP/M and to compare old S-100 CP/M systems with new PC machines without considering the newer S-100 products.

I would like to address these two groups separately concerning the state and future of the S-100 bus and *S-100 Journal*. I will refer to the first group as the "professional users" and the second group as the "hobbyists."

To the professional users: Although the **amount** of S-100 coverage in *Supermicro* will remain similar to what it has been in *S-100 Journal*, the **type** of coverage will likely shift, and it will shift in your direction. We will place more emphasis in higher-performance systems and applications. Your group has been mostly responsible for keeping the S-100 world growing by seeking out better performance systems, using or selling (in the case of OEMs) them, and buying the new products as they come out. Hang in there! I know that some of you, particularly OEMs and integrators, have had a few rough times because many of your customers (understandably) want to run MS-DOS software and graphics, and you have not been able to provide it, but that is changing now; as you see by this issue, TurboDOS users already have EGA graphics with full IBM compatibility. The same features for Concurrent DOS or UNIX should be just around the corner. Add that to the new multi/parallel processing capabilities of the newer S-100 systems, and you should have no trouble competing in an IBM world. The same goes for those buying: The newer features should make it easier for you or your company to decide in favor of S-100 systems.

Now to the hobbyists: The S-100 has its origins in the hobbyist community, and although many of you have gone on to become more professionally involved with S-100s or other systems, many still remain tinkering with micros for fun. Although *Supermicro* will not be a hobbyist-oriented magazine, you should still find many articles to be of interest. How many, it probably depends more on you than on us. I
(continued on page 50)



PC-DOS WITH EGA ON THE S-100 BUS

POPPY

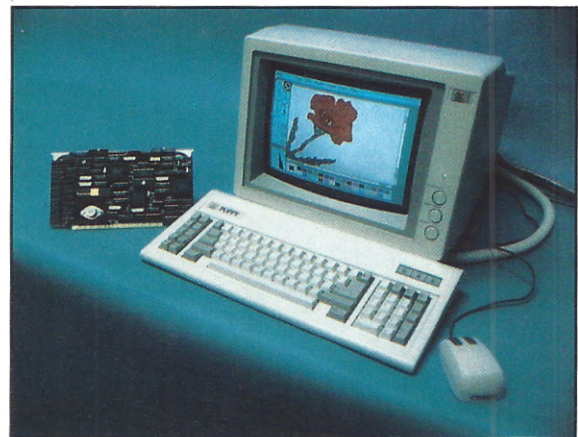
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Charter Information is the first to give you true PC compatibility in your S-100. We think you'll agree that POPPY will really add to your computing landscape.

Dealer inquiries are welcome.



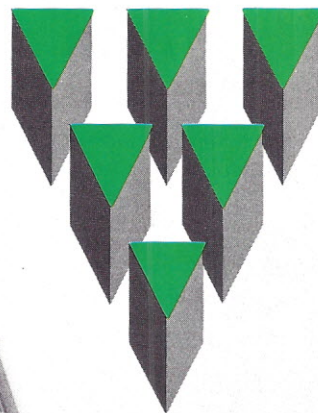
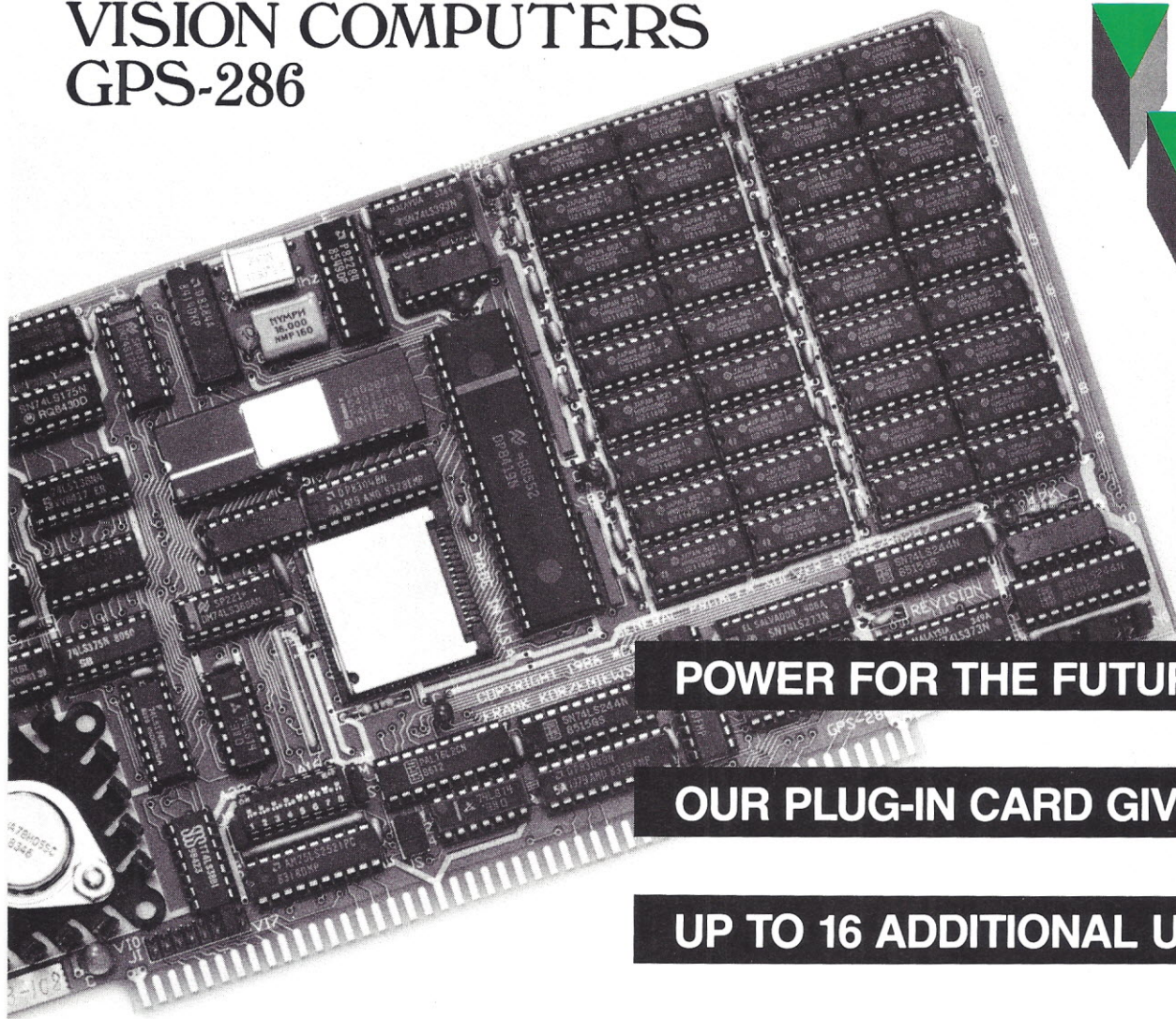
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FlexOS: A MAJOR NEW OPERATING SYSTEM

Frederick D. Davis

Multiuser OS is a regular column that discusses multiuser operating systems. The column discusses such operating systems as Concurrent DOS, TurboDOS, UNIX, d/OS, AMOS/L, OS-9, THEOS, etc. Each issue features one or more of the operating systems.

Readers are invited to submit questions they may have about any of the operating systems discussed. Answers to questions will be incorporated into future issues as space permits. Please send any questions or comments about this column to Multiuser OS, S-100 Journal, PO Box 1914, Orem, UT 84057. Letters should be typewritten, and each letter must deal only with one OS in order to facilitate forwarding to the proper columnist.

We welcome new columnists for Multiuser OS. If you have a solid knowledge about a multiuser operating system, you have access to a version of that OS preferably running on an S-100, and you would like to become a columnist, please contact S-100 Journal.

In this issue, the operating system featured is FlexOS 286. Although we know of no consumer versions of this OS running on the S-100, it is such a perfect match for the S-100 bus, that we just had to tell you about it. Hopefully, the OEMs among you will follow up on it.

Fred Davis is a programmer and consultant in Riverton, Utah. He specializes in custom applications for multiuser installations.

FlexOS is a new, full-featured, multiuser, multitasking operating system from Digital Research Inc. (DRI). It is available for the 80186, 80286, and 80386 processors. Unless otherwise noted, the version discussed in this column is FlexOS 286. Several characteristics set FlexOS 286 apart from other operating systems that run on 80286 computer systems. For example, FlexOS runs the processor in its protected mode.

FlexOS most significant feature is that it is designed from the ground up as a real-time operating system. The ability to start response to an event within a short and predictable period makes it ideal for scientific, medical, and industrial applications while in no way harming its utility for general usage.

FlexOS 286 addresses up to 16 Megabytes of memory and, because of the protected mode, memory of one task cannot be accessed by another task. Also, access to certain processor functions is restricted to the operating system or utility programs that have the proper status. Finally, the protected mode prohibits unauthorized direct hardware access.

Windowing is inherent in the operating system rather than an add-on program. As a programmer, you address these windows with an easy C function call. As a user, you may have multiple processes running in various windows. You can make these windows occupy whatever portion of the screen you desire by means of the supplied window manager. The operating system handles all the bookkeeping associated with overlaying one window on another and

restoring the previous window when the overlaying one is closed. And you can use as many as 255 windows per physical console under full program control. Windowing is equally easy on character-oriented consoles and bit-mapped ones.

All three versions of the operating system, 186, 286, and 386, share a common user and program interface. All operating system programming is done with the 286 version of the included C compiler.

In the Basic Tool Kit, you receive manuals totaling about 2400 pages, the MetaWare High C compiler, a FlexOS system, Kermit, and a lot of general system utilities. The utilities include FORMAT, DIR, COPY, ERASE, etc.; MAKE, GREP, and 15 other file and text manipulation utilities ported from UNIX; a simple full-screen editor, relocatable assembler, symbolic debugger, librarian, device drivers and sample programs. But this is only the entry level kit. With the System Builder's Kit you receive system object modules, the source code to the various drivers and utilities, and tools to relink the operating system, load, and debug FlexOS and its drivers as a task under Concurrent DOS.

GENEALOGY

Even though FlexOS was just released in January 1987, its genealogy goes back several years. An earlier version was originally developed and announced as Concurrent DOS 286 (CDOS 286) in the spring of 1985. Because of bugs introduced into the Intel 80286 when going from the engineering release to the production

release, CDOS 286 was available only as an OEM product. The current release of the 286 chip still has some bugs concerning 8086 programs (MS-DOS, etc.) in a protected mode. There are no problems with native 286 programs.

FlexOS was designed as a general purpose, multiuser, real-time operating system based on what DRI learned by doing several earlier multiuser, multitasking operating systems — MPM, MPM-86, and Concurrent DOS. They looked at how developers were using those systems and found that many were working with the systems' limited real-time capabilities. They also took into account what developers liked and disliked about other operating systems. You will find that certain elements of the FlexOS user interface bear resemblance to UNIX, VMS, Concurrent DOS, and MS-DOS.

GENERAL FEATURES

FlexOS provides a wealth of capabilities not found in most microcomputer operating systems. It was designed to be flexible in the extreme. It is modular in nature. Each device — disk, network board, serial terminal, printer, plotter, bit-mapped console, modem, analog/digital converter, etc. — interfaces with the operating system through a device driver. If you have more than one identical device, each one may be addressed through a subdriver. Device drivers and subdrivers may be loaded and unloaded dynamically at run time.

The operating system itself makes no assumptions about the hardware. It was specifically designed to be independent of any particular system architecture. FlexOS can therefore be ported to a wide variety of hardware simply by rewriting a handful of device drivers, boot loaders, and disk format utilities.

FlexOS was designed to allow multiple CPUs to be networked transparently to a program. With only a few exceptions, almost everything that can be done on the local CPU can be done over the network. The network can either be external (cable-linked) or internal (running multiple slave CPU/memory boards on one

FlexOS KEY FEATURES

- Real-time, multiuser, multitasking. Entire operating system is real-time from top to bottom.
- Protected mode operation.
- All memory addressable by CPU is available to OS.
- Gigabyte-size logical disks.
- No fixed number of disks.
- No fixed number of users.
- No fixed number of peripheral devices.
- Built-in support of multiple CPU boards.
- Equally facile windowing on serial and bit-mapped displays.
- Up to 255 virtual consoles (and windows) per physical console under program control.
- Windows managed by operating system in system memory.
- Operating system functions available to high-level-language function calls.
- Many of the operating system functions may be called asynchronously.
- Easy spawning of child processes and return to parent.
- Many kinds of code and data sharing.
- Most interprocess communications occur transparently over network.
- Program interface identical on all three versions of the operating system (186, 286, 386).
- Dynamically loadable and unloadable device drivers.
- Fast response to interrupts.

bus). In an internal network, each slave board would run a stripped down version of FlexOS, since disk and terminal I/O would be handled by the main processor. All network communications are handled through device drivers. A sample ARCNET driver is included if you buy the FlexNet supplement to FlexOS.

Installed in the S-100 bus, FlexOS would control the bus as an internal network. FlexOS would handle master/slave systems in a manner similar to TurboDOS which allows the mixing of 8- and 16-bit boards.

Unlike Concurrent DOS, FlexOS is specifically designed for multi-processor systems. But, unlike TurboDOS, it has the characteristics of a true multiuser, multitasking operating system rather than a multiuser networking system. Because of this,

intertask communication is typically the same whether or not the tasks are running on different boards.

With suitable device drivers, FlexOS can support 1 Gigabyte of logical disks. There is no built-in limit to the number of processes, users, logical or physical disks, and other devices. A logon/logoff procedure with passwords is provided along with various levels of file protection. As each user logs on, an individualized batch file is executed. This allows a specialized environment to be set up for each user.

The level of possible customization is extensive with the DEFINE command. It offers the capability to DEFINE logical names for drives, subdirectories, programs, and system commands. You can DEFINE any subdirectory on any disk as the

DEFAULT and/or SYSTEM drive. The DEFINE command allows easy customization of the user interface. However, only one logical name is allowed per command line. Logical names may be system wide, may apply to all virtual consoles for a given user or may apply only to one virtual console. You may also DEFINE the system prompt to be whatever you want.

Virtually all of the operating system functions can be called from a high-level language. Programs, including system utilities, may be run as a child process from an already running program with or without a return to the original (parent) program.

FlexOS has several ways to share code and data among programs even if running in protected mode. *Shared Run Time Libraries (SRTL)* are one method of sharing code. The libraries run as a separate process, keeping the data for each user in the user's own data area. The functions in the library can be accessed by any programs designed to use them. In the case of a large library, needed by many processes, a considerable saving in memory space can be achieved by using an SRTL. Another method of sharing code is to designate an entire program as shared. When that is done, only one copy of the program exists in memory for all the different users, but each user has his own data area.

Many operating system functions are performed by 40 *Supervisor Calls (SVCs)*. These may be easily accessed by function calls from high-level language programs. All of the SVCs have a synchronous (you must wait for completion of SVC) version. Additionally, ten of the SVCs have asynchronous versions. What that means is that you may call the async SVC to perform an action, i.e., call WRITE to send output to the printer, and go off and do something else while the output is occurring. That way your program isn't limited to waiting for the slow output to the printer or buffer and could actually be preparing the next output while the first is being transmitted. When convenient, you would then check on the status of the async SVC. If it isn't done, you give it more time. If an error condition exists, you handle it. If it was successful, you then continue with your program.

UPDATE: NEW VERSIONS OF CONCURRENT DOS

At COMDEX/Fall'87, Digital Research, Inc. (DRI) previewed Concurrent DOS 386 2.0 and Concurrent DOS 6.0 XM. Both versions should be released by the end of November, 1987. Also, the Concurrent Users Group (CONUG) sponsored a two-day programmer seminar. Several DRI representatives attended this seminar to gather information on what was wanted in Concurrent DOS and to describe the new versions.

Both 386 2.0 and 6.0 XM offer several new features. These are of course features from the DRI standard version. The OEM will make changes, usually extending and enhancing the standard version but occasionally leaving out features. MS-DOS 3.3 program support is now present. PC-terminals (Wyse 60, Kimtron, Ampex 232, etc.) are now supported. This allows well-behaved MS-DOS programs to run on remote terminals, which should increase the ability of S-100 systems to run these programs.

A number of changes regards disks. CDOS now supports 3½-inch floppy drives, hardware permitting. ESDI hard disk controllers are also supported, allowing a move to higher performance disk transfers. CP/M partitions on hard drives were dropped. MS-DOS media support has been enhanced to include password protection, two hard disks with up to four partitions of 512 Megabytes each, file sizes to 128 Megabytes, and MS-DOS-style field installable device drivers. Hard disk performance has been speeded up in general, and specifically in directory access for large hard disks and/or deeply nested subdirectories.

An important new addition is support for MS-DOS 3.3 byte-level record locking in addition to the native mode CDOS file locking. Multiuser software from the MS-DOS LAN environment, such as dBASE III Plus LAN, will now work correctly as multiuser programs purely within the CDOS environment, no network hardware or software required. In practical terms this means that hundreds, if not thousands, of additional multiuser programs are now available

for CDOS systems in addition to thousands of single-user programs.

For the first time, DRI is directly offering and supporting operating system versions for more than three users. CDOS XM 6.0 is available in 3- and 6-user versions. CDOS-386 2.0 is available in 3- and 10-user versions. OEMs will of course implement their systems for whatever number of users they want, just as they have done in the past.

The largest changes are in CDOS 386. Version 2.0 runs programs in the "virtual 86" mode. This is a special mode of the 80386 chip which makes a section of the memory look like the address space of an 8086 while giving you 'protection' from memory violations by another process. This same 'protection' prevents your application from accessing addresses other than those directly assigned to you. CDOS-386 can address the full 4,000 Megabytes native to the 80386.

CDOS-386 can run multiple ill-behaved (direct screen write or BIOS calls) MS-DOS programs on PC-terminals because the 'protection' allows CDOS-386 to intercept writes to "PC screen memory" and redirect them to other memory buffers and thence to a serial terminal.

A popular type of software on PCs has been the "terminate and stay resident" (TSR) programs such as Borland's SideKick. Many of these TSR programs can be run with CDOS-386 on PC-terminals. At the present, care is needed in their selection because whether or not they work depends on the program and its exact version. Further improvement is planned.

Release 2.0 of DR-NET was also announced. It will communicate with earlier versions of DR-NET running on requestors. The server(s) must be running one of the new CDOS versions with DR-NET 2.0. A major difference for the system integrator is that the network software is loaded as a device driver, not attached to the operating system as with earlier versions, making its setup and use easier. DR-NET accepts both CDOS and MS-DOS 3.3 system calls over the network.

Each process may have up to 31 outstanding async SVCs. Using async SVCs, a program may supervise multiple events concurrently.

REAL-TIME FEATURES

As mentioned, FlexOS was designed as a real-time operating system. In the past, if you wanted real-time multitasking operations on an Intel '86-based computer you could either use a full-featured operating system with only limited real-time capabilities or a very limited operating system with more real-time features. The latter have been more on the order of monitors rather than full-blown operating systems. They were for running programs and often lacked the capability for use as a development system. FlexOS is a full-featured general purpose operating system providing the resources for both executing and developing real-time programs.

Real-time, in terms of an operating system, means the capability to start response (output) to an event within a guaranteed time frame (36 microseconds at 8 MHz, no wait states with FlexOS 286) after its occurrence (input). For this, the operating system must know that an event — a write to a disk or moving a robot arm, for example — has taken place at the time that it actually has, in contrast to having an acknowledgment dumped to a buffer for later verification.

A genuine real-time system should remain real-time in all parts of the operating system. You can't turn off interrupts for extended periods of time, such as during disk activity, or you lose the capability of real-time response.

In FlexOS, upon an interrupt, control is handed to the appropriate *Interrupt Service Routine (ISR)*. FlexOS does not limit the size of an ISR. With the driver supplement to the System Builder's Kit, you can relink the operating system with your own ISRs, and you can write device drivers that include ISRs. The ISR would handle immediately critical responses or force a dispatch to an *Asynchronous Service Routine (ASR)*. Less critical needs would be handled by scheduling an ASR. The

priority of the ASR can be set according to the urgency of the task. ASRs are then dispatched according to their priorities, or dispatches can be forced by an ISR. After all ISRs and ASRs are completed, control is transferred to other processes according to priority.

MS-DOS COMPATIBILITY

FlexOS 286 has a limited ability to run MS-DOS programs for several reasons. FlexOS always runs in protected mode. User programs have no authorization and hence no capability to directly access hardware or memory addresses other than those specifically assigned to each program. This creates several problems for many MS-DOS programs. A clean break with past programming practices of going outside the operating system is needed for FlexOS and other protected mode operating systems.

FlexOS also intercepts several MS-DOS BIOS calls and software interrupts. These must be specifically intercepted and simulated. Programs that try accesses other than those specifically provided are either ignored or aborted for a memory violation. This problem can originate with either the program or the language used. Because of a bug in the 80286 chip, programs that use instructions to load segment registers must use a software emulation routine. This causes slower software performance.

The front end of FlexOS currently supports MS-DOS 2.x (3.3 on 386) system calls. Future versions will support 3.x system calls.

USER INTERFACE

FlexOS has multiple virtual consoles (VCs) as does Concurrent DOS. A VC looks just like a physical console to your program. The console output is done through a console driver. Currently EGA, CGA, and character-oriented console drivers are supplied. The stock *Window Manager* supports six user VCs, a *Window Manager Help* window, and a message window per physical console. You may use the message window, under program control, for displaying

messages up to 10 lines long and for receiving up to one line of input.

A VC may either be a bit-mapped or a character-oriented console. A window is a view into a VC that may be all or a portion of a VC, but not larger than the physical console. Your application always has access to the full VC regardless of the size of the window. Under program control, you may have up to 255 VCs per physical console. When you close a window, the underlying window is restored by the operating system. A mouse, if present, and keyboard go together to any one VC at a time.

The FlexOS command syntax will be somewhat familiar to users of MS-DOS, Concurrent DOS, UNIX, and VMS. Elements of all of these are incorporated. The standard system prompt is the familiar "A>" unless you DEFINE it as something else. Subdirectory references may use either slashes or backslashes.

Command line options use the "-" as the switch character by the default definition, so a request for a wide directory would be "DIR -W." If you don't like that you could "DEFINE WD = DIR -W." After that you could use WD or DIR -W.

LANGUAGES

The developer kit comes with the extremely fine MetaWare High C compiler. This compiler fully supports the proposed ANSI C standard, offers a Lattice compatibility mode, and includes a number of unique proprietary extensions.

The 286 version of High C supports the entire 8086 family of processors and numeric coprocessors through the 286/287. The newer 286 version also provides limited 386 support with a few 32-bit operations and 387 in-line code generation. The 386 version is only for the 386 chip in protected mode.

The object modules of High C may be linked with those produced by the MetaWare Professional Pascal compiler, also supported on FlexOS. Additionally, Ryan McFarland FORTRAN is in the process of being ported to FlexOS. Other languages may become available in the future.

Three different editors are available for use with FlexOS. Supplied with

the system is DREDIX, which, while a far cry above ED, leaves much to be desired. A FlexOS version of the public domain Micro EMACS is available from some bulletin boards. VEDIT PLUS from CompuView Products has just recently been released for FlexOS. VEDIT is a full-featured programmable editor with extensive customization and macro programming capabilities. It is also very fast.

GRAPHICS

Presently, FlexOS has drivers for EGA and CGA devices. With version 1.31, a beta version of the multitasking *Virtual Device Interface (VDI)* is being shipped. The VDI is the lower level of the *Graphics Environment Manager (GEM)*. The VDI provides graphics primitives for easier graphics programming and device drivers that make your programs device independent. The

version being shipped with FlexOS 286 is limited to screen output only, and it is provided as a sample to developers to show what can be done.

DOCUMENTATION

While the FlexOS manuals are massive and reasonably complete, they are poorly organized and are missing some classes of information entirely. The manuals appear to have been written over a period of several years, some dating back to the developmental period of CDOS 286 and others adapted from other operating systems. They suffer from a number of shortcomings. There is no overall index or table of contents. To try to gather all of the information on a given topic, you may have to look in four or five indices and as many tables of contents. There is some inconsistency of terminology which makes finding things even

tougher. The MetaWare High C manuals are complete and moderately well organized, though there are some proofreading errors.

There was one type of coverage that I found glaringly lacking in the FlexOS documentation. Nowhere are details given on how to perform many of the user-oriented functions; things like running programs that use the EGA card on one VC and character displays on another, or specifying the limitations of the DEFINE and other commands. Generally speaking, there is much definition and little or no explanation. Interrelationships among features are virtually untouched.

There is a serious lack of any documentation on exactly what has to be done and in what order in CONFIG.BAT. That file excutes on boot-up to load drivers, define device names, and define default and system names. It is all too easy to make an error in that file and give yourself a nonworking system. ►

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FlexOS 386

With the imminent release of FlexOS 386, you should be aware of the differences between FlexOS 386 and FlexOS 286. The main difference is that FlexOS 386 can address the full 4-Gigabyte memory of the 80386 chip. A single process may use up to 3 Gigabytes, your hardware permitting.

The same C compiler, the 286 version, is used for the operating system on both the 286 and 386 versions. Drivers developed on one version are directly transportable as object code to the other version. The only catch is that application programs need to be developed on the 386 version of the compiler in order to access the 386 chip modes and address space. Both versions of the compiler are available by themselves or as part of different kits (see table of prices).

FlexOS 386 has a much greater ability to run 8086 programs, specifically MS-DOS at this time, because of the virtual 86 mode of the 386 chip. MS-DOS 3.3 level calls are supported in general. A few specific productivity enhancement applications, such as Lotus and some word processors, appear to work well. Testing of these applications by DRI has not been extensive because the intent of FlexOS is to support native mode applications, not to be a multiuser, multitasking MS-DOS environment. If this is what your needs or desires are, check out Concurrent DOS 6.0 (8086, 80286 environments) and Concurrent DOS 386 2.0.

WHO IS FlexOS FOR?

The customer that DRI wants is an OEM customer. They are not set up to provide any consumer support on this product. The operating system is primarily designed to be sold with specific task-oriented hardware and software. The developer provides all customer support.

FlexOS has all the basics in place to be a good general-purpose, scientific, and process control operating system. It appears to me to be the strongest microcomputer real-time operating system available. The present marketing effort is directed

towards applications that need the real-time characteristics. There is nothing to prevent somebody from making the necessary enhancements, smoothing the rough edges, providing support, and marketing a specialized version of FlexOS.

At present, there is a moderate amount of industrial usage of S-100 systems, many running Concurrent DOS with its relatively limited real-time characteristics. FlexOS has the flexibility and features to compete with operating systems occupying much more costly hardware. With the increasing power of the processors (386 and beyond), the hardware, too, will be able to rival the power of far more costly minicomputer hardware. With FlexOS and 286 and/or 386 main and slave processors, very cost-effective, versatile, and powerful S-100 systems could increase their market penetration in areas traditionally dominated by minicomputers.

Any integrator who needs a powerful operating system that can be extensively customized should certainly look at FlexOS whether or not the real-time characteristics are needed.

CONCLUSIONS

FlexOS 286 is not ready for general-purpose usage for several reasons. First, there are very few application programs (word processing, spreadsheets, accounting, etc.) available in native 286 mode, and many 8086 programs will not run or not run quickly enough, for the reasons previously discussed. Second, the user interface is rough around the edges. It is not user friendly in the typical sense. There are not as many utilities available as are really needed. Those that do exist are essentially ports from existing operating systems; none are specifically FlexOS in nature, taking advantages of its unusual features, such as async dispatches of various tasks.

Finally, there are only a few drivers available; others you would have to write yourself. You can't buy a 16-user system off the shelf. No drivers exist to use a Televideo-compatible terminal. The documentation is inadequate for a consumer product.

FlexOS is a young operating system. It needs some time to mature.

Up to this time (release 1.31), updates were mostly for fixing bugs. Now that most of the bugs are fixed, the emphasis will be on enhancements. The documentation is being rewritten. Productivity programs for 286 protected mode will become more available. Programming aids and utilities will be developed as more work is done on FlexOS.

FlexOS is a product of:

Digital Research, Inc.
P.O. Box DRI
Monterey, CA 93942
(408) 649-3896
(800) 443-4200 (sales)

FlexOS versions:

80286
80386
80186 (supplement only)

Documentation:

380-page Programmer's Utilities Guide
38-page Programmer's Utilities Guide Supplement
308-page Programmer's Guide
272-page System Guide
308-page User's Guide
321-page GEM VDI Reference Guide (286 version only)
68-page FlexOS 286 Supplement (different for each chip)
38-page Kermit Guide
718-page MetaWare High C manuals (in aggregate)

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386 Basic Tool Kit, 386 compiler	\$2495
386 Sys Builder's, 286 compiler	\$2995
186 Supplement to Sys Bld Kit	\$500
FlexNet Supplmt to Sys Bld Kit	\$500

FlexOS is being covered as a special interest topic by the Concurrent Users Group (CONUG). A variety of utilities, drivers, and the like will probably become available on their Bulletin Board and library.

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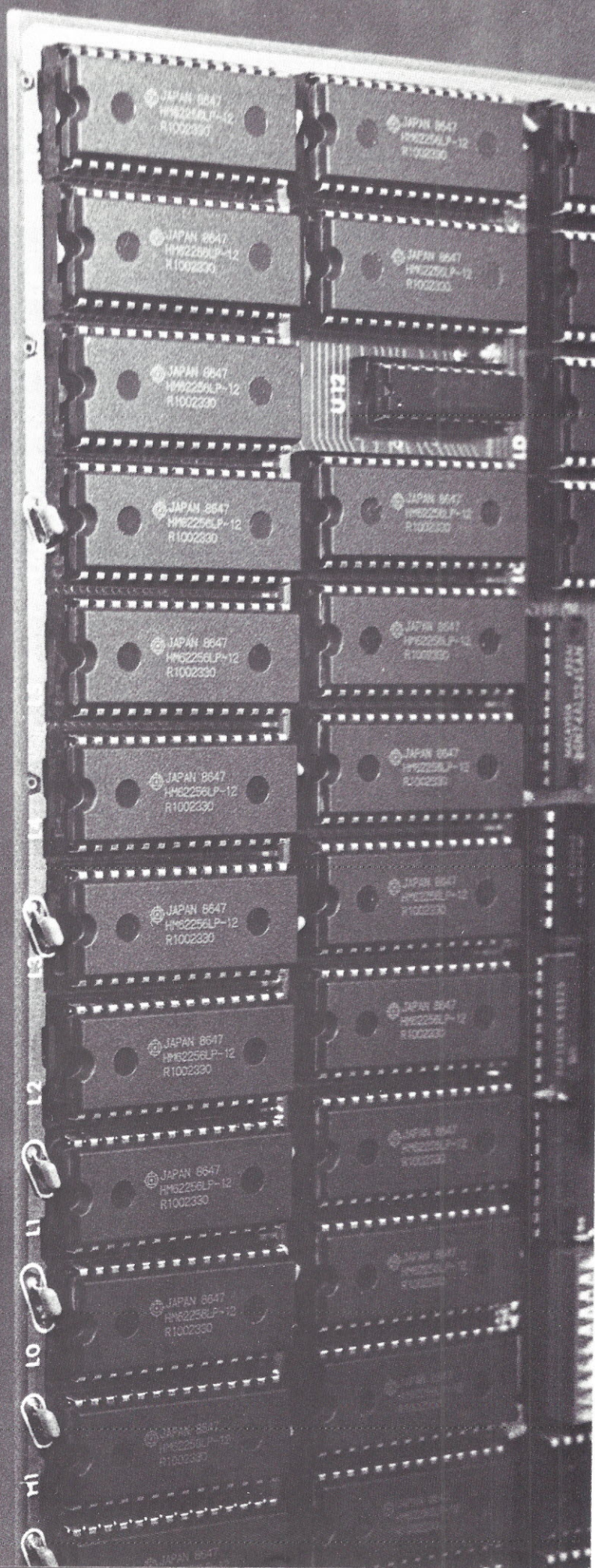
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```

TEXT LINE: 15 COL: 16 FILE: PHOTO .283 INSERT E1
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/* Main loop - displays the ma
do {
    scrlines = SCR_LINES;
    scrwidth = SCR_WIDTH;
    clrscr(scrlines-20);
    show( main_menu );
    ret_val = getrange( mm_pro
process( ret_val, (new_ved
) while ( ret_val != EXIT_OK )
    .sp 2
if (new_vedit && (table_in !=
printf( crt_sel );
if (yesno(" ")) setcrt( ar
else outcrlf();
}
WINDOW $

```

DIRECTORY C:\VEDIT\NEW
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Macro execution window	No	No	No	Yes
Trace & Breakpoint macros	No	No	Yes	Yes
Execute DOS commands	Yes	Yes	Yes	Yes
Configurable keyboard				
Layout	Hard	No	Hard	Easy
'Cut and paste' buffers	1	1	1	36
Undo line changes	Yes	No	No	Yes
Paragraph justification	No	No	No	Yes
On-line calculator	No	No	No	Yes
Manual size / index	250/No	42/No	469/Yes	380/Yes
Benchmarks in 120K File:				
2000 replacements	1:15 min 34 sec		1:07 min 6 sec	
Pattern matching search	20 sec	Cannot	Cannot	2 sec
Pattern matching replace	2:40 min	Cannot	Cannot	11 sec

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OLD WHINES AND NEW VINTAGES

Jack L. Chalker

Buslines is a regular column that addresses topics of general interest to S-100 users. Jack L. Chalker, our Buslines columnist, is the prolific and well-known author of 34 novels, mostly science fiction, including six best sellers so far. Jack has been a computer technician, rock concert engineer, audiovideo consumer electronics reviewer, teacher, book and magazine columnist, computer typesetter, Air Force public relations man, book and magazine publisher, and a host of other occupations before he found his niche in writing and stayed there full time. He is a dedicated S-100 user always looking for and buying the latest state-of-the-art hardware and software.

In Buslines, Jack gives his user's viewpoint, lets you know what products work well, poorly, or not at all with his S-100, and offers general commentary on S-100-related matters. The opinions expressed are his own and may or may not reflect the views and positions of S-100 Journal.

If you have any comments or questions concerning the topics of this column, please write directly to Jack L. Chalker, Buslines, c/o The Mirage Press, Ltd., P.O. Box 28, Manchester, Maryland 21102. Be sure and put Buslines on the envelope.

Response hasn't exactly been overwhelming to my plea last time to be kept informed of what's going on Out There in the S-100 World by those doing it, but a few developments have fallen into my lap in spite of that: a pleasant surprise and a couple of *It Sounds Great Buts...*

There are three major Concurrent DOS (CDOS) BBSes in the country: Alex Soya's Florida-based Goliath, Bill Spoolhoff's California-based MCI board, and the northern California-based and DRI-connected CONUG BBS that's for members of the CDOS User's Group. There's much overlap on each board, but enough is different to force me to make the phone company happy and check in on them often. Fixes for things like the CompuPro CDOS 5.0 clock bug, discussions of various hardware and software, and the solution of practical problems make them a must for anyone heavily involved in the industry side of things. The two personal boards are highly technical, but if you use any version of Concurrent, you should be a member of CONUG. The newsletters alone are worth the price of admission, and the free programs and utilities on their BBS are worth far more than the \$25 annual fee.

Other than their concern with CDOS, these boards also have in common Alex Soya's Goliath BBS program, perhaps the friendliest, most goof-proof, and easy to access and use BBS program now in use (I think it's commercially called CALLUS). Even CompuPro bought and uses this BBS system, which is CDOS based, for its own internal BBS. I have

neither the time nor patience to run a BBS system; I used to edit and publish a small magazine and I can imagine having to monitor a large system on a daily basis and want no part of it, but if you're running CDOS and are interested in the best, it's the one to buy. Soya, by the way, runs his BBS with a 386 PC networked via CPLink into a CompuPro 816 running a fast 286 and managing something like 160 megabytes. The software house that sells CALLUS, Concurrent Research, can help configure it to whatever you've got or need.

I mention this not only to give a plug after slogging through the arcane and clumsy UNIX and mainframe systems used by BIX and GENIE and the like, but because Soya has produced another program, Voyager, this one for the rest of us. And it's a doozy in performance and priced so inexpensively that I can't imagine a CompuPro owner, at least, without it.

Those of us who bought CompuPros received Amcall II with it, perhaps the clunkiest and clumsiest communications program around for micros, whose only saving grace was its included networking options. About the only other choice for the S-100 world was MODEM, a more or less shareware product that did a nice job but sacrificed utility and accepted many limitations for a degree of friendliness and a more rational interface. Still, unless you had a company programmer on retainer to work you up a custom job, S-100 CDOS users were left looking in the bright windows of Crosstalk and

PC Talk and their cousins while stranded outside in the cold snow-drifts and with no key to get in.

Voyager changes all that in an instant and does something else that is remarkable: it not only has an S-100 CDOS version with most every feature you could want at a price cheaper than most major PC communications programs, it also comes in an even cheaper MS-DOS version, so you can travel between the two worlds without having to learn anything new. In other words, it's not only the state of the art in communications for CDOS at long last, it's also a very good and quite competitive MS-DOS program.

There are a lot of talented programmers out there but, pardon me, most think in computerese and are so involved in their own programmer's world that they have almost a contempt for us poor folks out here who actually have to use the results but don't speak a word of C or assembler. Alex Soya has the knack of looking at it from the end user viewpoint; his BBS is a joy to use and, I'm assured by those who do it, it's the best and easiest system to manage as well. His communications program is no different.

Voyager is so friendly it's like a small puppy, eager to please. Installation is simple and straightforward from an automated batch file and takes only a couple of minutes. Adding your important names and numbers to its memory files using a simple fill-in-the-blanks form takes barely longer than typing it in. Like any good communications program these days, it supports almost any known modem (and can be custom configured if your modem's an oddball), 7 and 8 bits, 1 or 2 stops, parity, etc.

Unlike most, Voyager can support more than one modem for concurrent work (!), allowing you to use a single program for all your complex needs, and while it's probably easiest to use with a PC-like keyboard, it works just fine on a multitude of standard serial terminals substituting escape sequences for the PC F-keys. Since it addresses CDOS in the operating system's native mode, the terminals can do virtually anything the PC type can do, and Voyager, which makes extensive use of overlapping windows, even windows on my Esprit III

Televideo Clone. There are probably terminals that won't work directly with Voyager, but with the list provided and the customization options available in install, it's hard to imagine one that wouldn't so long as you have the terminal or modem manual around someplace.

While I tried it with the Esprit just to see it run in terminal mode, I personally use it entirely with PC Video day to day, and it's the PC keyboard version that I used for putting it through its paces. The difference is almost entirely in the fact that you have to hit a three-key escape code for the various features on a terminal rather than a two-key function code on the PC keyboard. On screen and in operation, there is otherwise no difference, and that's impressive in and of itself.

Even in setup, Voyager has some pleasant surprises. By simply putting the baud rate in the dialing directory, you negate any need to have more than one master file to run at different baud rates, echo configurations, etc. The baud rates supported are all the standards, and some that seem sheer optimism now (speeds up to 38K baud are supported) but might still be useful to someone in a computer-to-computer direct wired transfer, for example.

In my case, which is very simple compared to many user's needs, I still had to have three Amcall zip files to access the various services I needed and had to remember which to invoke at the command line. No more. Each line in the dialing directory gives the modem its independent marching orders.

Perhaps the biggest negative is feeling like a Trekkie every time the program is invoked — VGR is required, the name of the enigmatic alien ship in the first (and pretty dull) *Star Trek* movie.

Once installed, typing VGR brings up the serial number and puts you in terminal mode from which you can go in many different directions. For most uses, you simply hit ALT-D to bring up your dialing directory, then you just use the cursor to point to any line or number and hit RETURN. This brings up the dialing screen, which displays exactly what it's doing as it's doing it, typing the number and also giving a visual indication of its dialing

in the form of a slowly changing symbol representing ringing. If it gets a connection and your modems mesh, it immediately goes to a blank screen. The interface here most closely resembles the MS-DOS commercial program ProComm.

The only glitch that surfaced, and it's not really a glitch, is that you will know if your system isn't wired properly for a modem, or if your modem is not set up right, once you use VGR. My modem had a previously undetected intermittent short in Pin 8 (carrier detect) and caused some initial headaches that I blamed on the program until it was tracked down.

That said, this is one heck of a program. In effect, this very complex piece of software has no known bugs even in its initial release version, which is almost unheard of, considering the nightmare of configuring this sort of thing for the complexity of the S-100 world (no two exactly alike).

Once inside Voyager, help and reference to all function keys is available in a window with a push of ALT-F10; using any command gets rid of the window automatically. And there are a lot of commands, all very handy to have.

Many are simple toggles — ALT-B toggles capture on and off; ALT-Y shifts from full to half duplex and back on the fly, which has proven very handy indeed, and so on. Equally handy, and a good example of human engineering here, is ALT-C which clears the screen while online. Another unique example is ALT-J, the "jump CHAT" mode, which is wonderful for anyone who has to be on line in any sort of multiparty conference call. It gives you a split screen, with the other folks' typing up top while your replies are at the bottom, making sense out of potential messes when one sender sends while you're trying to respond.

Uploads and downloads couldn't be simpler. You simply hit PAGE UP to upload, PAGE DOWN to download (terminals use escape sequences for the same thing, so don't worry if you don't have an ALT key or the special keys I refer to). This brings up a window menu where you can choose from a large number of protocols and, after you choose, it automates the send and receive process, so all

you need do is signal the remote system and type in a file name.

Most transfers resemble the MS-DOS standards; XMODEM mode, for example, brings up a window during the file transfer process that shows the complete status including errors and retries as it goes along. Other protocols supported have similar status windows, so you're always sure of what's going on and what's possibly going wrong as well. The windows resemble those in MeX and fully support more useful protocols than Crosstalk for the PC.

ALT-0 to 9, by the way, are reserved for macros. You can make those combinations send almost anything you like, so if Voyager forgot something you just have to have, you only have to put it in yourself. Common logon strings, etc. can also be bound to those keys.

In other words, if all you use are commercial databases and services, you can pretty much use Voyager

out of the box without even reading much of the manual. It's that friendly.

Businesses, however, and programmers, want and need more, and for that Voyager provides its own script language and its own script compiler for compact and executable script files for almost every use. The compiler is very good; as it compiles it displays the source file on screen, and if it gets any syntax errors or sees anything that would make the file not executable by Voyager, it will flag it and insert an error message just after the problem telling you just what the problem is. Script files of up to 10,000 bytes of compiled code are permitted, and that's a pretty big and complex script file. Although the script language is not very difficult (it's far simpler than any programming language, dBase program language, or even most other script-based communications programs), it is quite versatile and allows for a large number of variables to be inserted and hand-

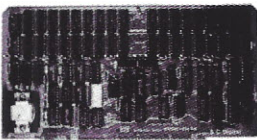
ed. Using it, it's possible to automate virtually every phase of modem operation. IF-THEN and ELSE statements are easily handled by it, as are REPEAT, UNTIL, WHILE, and FOR. It handles multiplying, adding, and relational operators covering virtually any need I can think of and quite a number I can't think of but some of you probably can.

The program is more than I'll ever need. No, it isn't up to the absolute top-of-the-line MS-DOS programs — yet — like Blast and the far more complex Crosstalk Mark IV, but it's very close, and it has features and can do some things those single-user programs can't, and it's a product just starting out. Writing dial-up macros for, say, point of sale inventory, should be a snap here, and you can certainly do more with this one than with any other communications program for CDOS and S-100 computers.

All right, I know that Real Program-

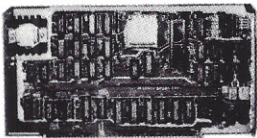
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MODEL 256KMA



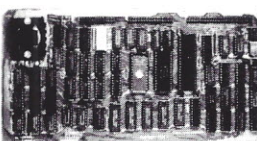
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MODEL 80286CPU



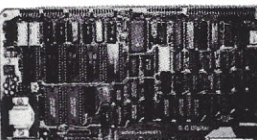
256K/1M DYNAMIC RAM board Model 256KB-256 \$325
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128K/512K STATIC RAM/EPROM Model 128KS \$235
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mers eschew all this automated stuff and all this nice help and friendly error messages and want to *sweat*, but Voyager is for the rest of us, including small and medium sized businesses that are CDOS based. And, if you have a particularly nasty bit you can't figure out how to write no matter what, Concurrent Research sells the services of its own programmers for customized script files and even customized versions of Voyager at reasonable rates.

For CDOS users, Voyager appears to take up 128K or less of TPA, which means that while in it you can run concurrently just about any other program you have, or you can call in for your electronic mail while your spreadsheet's recalculating or your humungous database is being resorted and reindexed. Most important of all, CDOS users, particularly in the CompuPro world, no longer have to do without all the sophistication and convenience that the MS-DOS world takes for granted in communications programs. This is right up there with the best of them. The documentation is basically typewritten and spiral bound, but it's well organized, easy to read, contains essential glossaries of all its terms, and, most important of all, an index.

It must not be underemphasized that these features are available not only with PC Video or a PC or ANSI/PC compatible terminal, but on almost any popular serial terminal — windows and all. If your terminal has decent line graphics capabilities and contains a control and an escape key and the basic QWERTY keyboard, then Voyager offers all this sophistication and every feature. Try that with any of the MS-DOS communications programs!

All this brings me to the cost. For CDOS users (specify version — 4.1, 5.0, etc., and that you're using it on a CompuPro and not a PC-type computer when ordering) Voyager currently sells for \$169. If you also have an MS-DOS machine around, there's a version for it as well that looks and feels the same (but lacks the concurrent abilities) for just \$99. By comparison, Crosstalk for MS-DOS recently charged \$75 just for its upgrade! Upgrades for Voyager will be available at a 'nominal' charge.

After just three weeks with Voyager, I can't imagine going back to anything else. For CDOS it's the only choice, and I'm using the MS-DOS version for the Toshiba laptop as well.

The something old comes out of a comment I made on Alex Soya's CDOS BBS system last summer lamenting the fact that CompuPro users couldn't use some of the nice SCSI devices (even though we might have said SCSI port) because they all seemed tailored to the IBM serial world. As an example, I gave the Bernoulli Box, a very nice removable storage medium that turns what is effectively a cartridge-encased 8-inch floppy into a truly crash-proof 10-Megabyte hard disk. Part of this was prompted by a need for such a thing here, and part because Iomega, the Bernoulli Box manufacturer, had just drastically dropped the prices on them and they were now cost effective.

I heard almost immediately from Mr. Emil Bohach, a former CompuPro systems center man, who stated that not only had he been running Bernoullis on his CompuPro for years, he'd set them up for many customers and even set up BBS systems that were CompuPro-Bernoulli based. All you needed was a 'dumb' SCSI board (which he had around) and his drivers and, of course, a Bernoulli Box. The only problem was that he'd never upgraded from 4.1E to CDOS 5.0C as I had, and so he hadn't any idea if they worked under 5.0 or not.

The answer, alas, is that his drivers do not work under 5.0 at this writing, and don't seem to be able to be made compatible. I'm now hoping that he will eventually upgrade to 5.0 himself and be forced to change the driver to work there. As it is, the only way to use it is as a mass backup system, resetting with a floppy version of 4.1 before using or backing up. So close...

For those still using 4.1, however, or who only want a good backup system, it does work. Bohach is out of the S-100 business (indeed, he's currently selling real estate), and the drivers aren't commercially available now, but if there is sufficient interest out there among S-100 CDOS users

in Bernoulli drivers, he'll certainly start selling them again. I suspect that there would be — if he'd reconfigure those .rsp files for 5.0. It would be particularly nice if he also got a System Support 2 board, which contains a dumb SCSI port, and used that instead of a separate board. There is so much unrealized potential in our S-100 systems out there, and this is just one example. It's the increasing tale of, "Sure, we could do it and it would run rings around anything IBM might come up with, but there's not enough of an installed user base left out there interested in these projects to finance start-up and tooling costs." Sigh.

That, in fact, is the problem with a lot of S-100 development these days. CCT out in Arizona developed a small "S-100 to IBM bus" box more than two years ago that uses the PC Video interrupts on a CompuPro, thus enabling a CompuPro user to use an EGA, PGA, or VGA card and monitor with no other alterations. Unfortunately, it costs a fair amount to make such devices, and they're only commercially viable if enough people buy them to drive the manufacturing costs down. So far CCT hasn't seen sufficient interest in EGA (or better) compatibility from the S-100 community, particularly at any reasonably profitable price, to warrant actually manufacturing the box. Although there appears to be hundreds of S-100 owners out there pining for EGA or better video, you apparently need thousands to make it profitable. If you are running a CompuPro and would really like EGA or better video, you should write CCT and tell them so. If they get enough real interest they might offer the thing for sale, but so far not enough have expressed interest to make it worth the financial risk.

Right now, it appears that the only way any S-100 owners can get the really sharp graphics currently enjoyed by the IBM world is by purchasing a clone with EGA or better card, buying CPLink and the Net 100 board, and networking the clone into the S-100. For those with an office full of IBM-type machines and a master S-100 machine, that might well be the best and most cost effective way to go, but if you're a 100% S-100 operation it's a costly way to get a decent-looking graphics screen.

That, of course, is our greatest enemy in the S-100 world — the cost effective trap. If we had even a couple of thousand people who wanted and needed and would pay for an EGA card, we'd have one very quickly — it's not that hard to do. But if there's only a hundred, or if it's *perceived* that there are only a hundred out there, then the cost of making the boards is simply prohibitive.

Now, I'm convinced that there *are* enough S-100 owners out there to support such a project, but you aren't very vocal about your wants and needs, I'm afraid. Maybe I'm wrong — but let's see. Let's use this column to vocalize those desires. What would you like to see in new hardware for the S-100 bus? What capabilities would you like to see? Drop me a line and let me know. I'll compile them and report them here, and if there's a really large demand for any one thing (like an S-100 EGA/VGA board, for example) I'll also contact a potential source of that and show

them the evidence. If my mail remains low and you remain silent, though, then it's not going to happen. Don't write *S-100 Journal* for this purpose; send it directly to me, care of The Mirage Press, Ltd., P.O. Box 28, Manchester, Maryland 21102.

Our machines are faster, better built, more reliable, more versatile, and run rings around the current mass market busses and operating systems, yet in some areas they can do things in their world we can't here simply because the installed user base is so large. Let's hear from you. What do you want (and would be willing to buy) for your S-100 machines? Not just video attributes — anything at all. Just drop me a note and tell me. That's a way you personally can help keep the S-100 world vital and alive and growing. If you don't, then don't complain.

Footnote: The Bernoulli Box syndrome strikes again. As you can see by this issue's front cover feature, there *is* a company now marketing a

fully self-contained S-100 EGA on a full coprocessor board. The answer to our current dreams, except (sigh) it's only available for TurboDOS...

And this is really ridiculous. Not to denigrate TurboDOS, which from all reports is a fine operating system, but its installed user base is to Concurrent what Concurrent is to MS-DOS. If somebody can come up with a commercial EGA for TurboDOS, then where's the one for CDOS users? What about it, Macrotech? Lomas? Whoever?

And speaking of Macrotech....

I was initially less than enthused by Macrotech's announcement of a 16-MHz 386 board; it seemed to me that it was just another coprocessor using the current glamor chip but didn't really offer anything practical that a 286 SPIO board wouldn't. It seems, though, that they may really have something here.

The 386 is a slave board, a true coprocessor rather than a SPIO
(continued on page 43)

RAM DISK

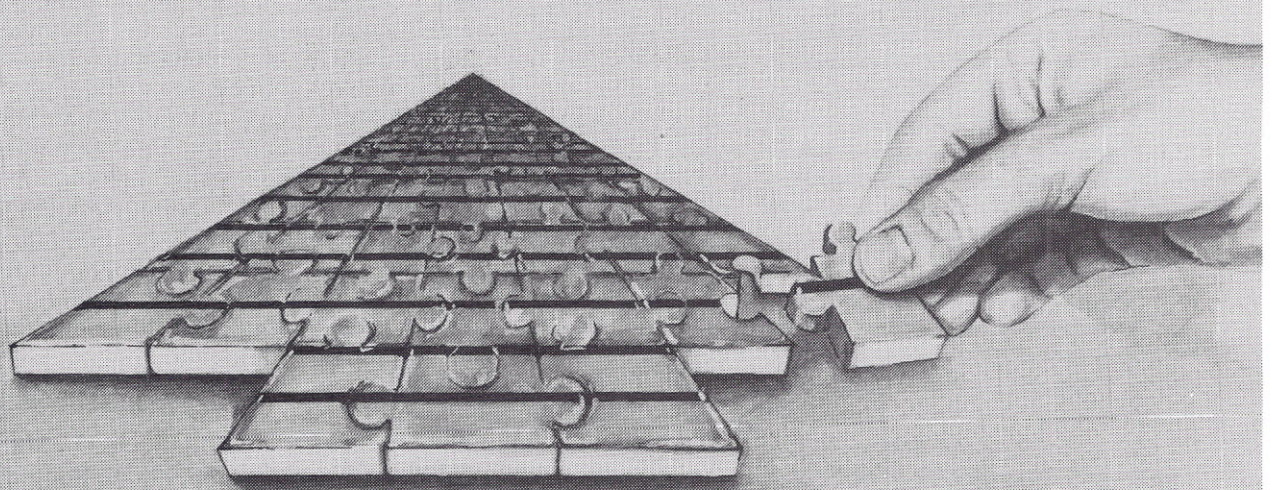
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MULTIPROCESSOR SYSTEMS

Don Pannell

One of the best features of the S-100 bus is its ability to support many processors. Originally designed around the Intel 8080 CPU, the S-100 bus today supports virtually every major CPU. The list includes Z80, Z8000, 68000, 32016, 80286, and even the 32-bit chips, 68020 and 80386.

It gets better. S-100 goes one step further than most systems with its ability to support multiple processors at a time in one system. Common multiprocessor installations are TurboDOS systems where each user gets his or her own CPU with local RAM and I/O. In these powerful and flexible systems, additional users can be added without system degradation.

Other multiprocessor systems allow the user to run a wider variety of software by supporting different types of processors in one system at the same time. The classic example in this category is CP/M 8-16 which will run CP/M-80 (CP/M 2.2) or CP/M-86 programs on the 8085/8088 dual processor board from CompuPro or on the Z80/80286 dual processor card from Macrotech.

In this article, I will present a historic perspective of multiprocessor S-100 systems. I will discuss several ways that extra CPUs have been added to make multiprocessor systems and PROs and CONs of each approach.

THE DUAL PROCESSOR

The first S-100 systems ran CP/M 2.2 on hardware that allotted each system function to a separate card. The CPU card contained nothing more than the CPU. These systems had separate

RAM, floppy, and I/O cards. The separate-function-per-card approach is great when it comes to upgrading a system. A new card/function is simply added or an old one replaced without the need to replace the entire system. This very feature was key to the design of the first multiprocessor systems.

In early S-100 systems, the first processor upgrades consisted in replacing the old 8080 CPU card with a Z80 CPU card. Doing so usually doubled the speed of the original system while at the same time allowing access to a processor with a far superior instruction set. These upgrades were easy to justify since all the owner's original software investment was retained (the Z80 is 100% software compatible with the 8080).

With the next advancement in processor technology, namely the 8086/8088, the backward software compatibility issue was not as easy a problem to solve. The 8086 is architecturally backward compatible with the 8080, but it is not object code compatible. This is where CompuPro's 8085/8088 *Dual Processor* board came in. By having both processors on the same CPU card, the user could still run all her old software on the 8085 and then switch to the new 8088 processor to run her new software.

Therefore, the first multiprocessor systems simply contained two different processors on the same card strictly for backward compatibility. With these cards, multiprocessor does not mean high-speed multiuser since only one processor chip is active at any given time. While one processor is running, the other is placed in a

Do you have a technical question about the S-100 bus?

Is there an area of the IEEE-696 standard that you do not understand?

Do you need to know how to interface a particular device or function to the bus?

696 Bus is our regular column that helps clarify questions and concentrates on the hardware aspects of the IEEE-696 bus (i.e., the S-100 bus).

Don Pannell, our S-100 bus expert, has been using S-100 systems and designing S-100 boards since 1978. Don was a coauthor of the IEEE-696 standard. This is the standard that defines the rules of operation of the S-100 bus. Adherence to the standard permits boards from different companies to work with each other.

If you have a question about the S-100 bus and IEEE standard, please type your question and send to Don Pannell, PO Box 700112, San Jose, CA 95170-0112.

In future columns and as space permits, Don will incorporate answers to questions received from readers.

hold state. Switching between the two processors is done by reading a specific I/O port (typically I/O address FD hex). Installation of a dual processor board required replacement of the original CPU card. Also, only one dual processor card is allowed per system since these boards are permanent bus masters.

THE ATTACHED PROCESSOR

The dual processor card solved the upgrade problem for many users, but it didn't help those who needed to run Z80 code. For these people, Ski Electronics developed an 8088 CPU card that 'attached' over the bus to any other permanent bus master card, including Z80s. The SKI88 card basically implemented the dual processor card on two cards — the buyer already had one half and could then purchase the other. Installation allowed the user to keep her original CPU card and simply add the *Attached Processor* in any available slot in the system.

Attached processors are identical to the dual processors in that only one processor can be active at a time and processor switching is done by I/O port control. And again the main goal is to retain the original software investment by maintaining the backward compatibility. Attached processors have the added advantages, however, of wider CPU combination choices as well as the ability to support more than just two processor types. It is possible to have more than one attached processor connected to the permanent bus master (but still only one CPU can ever be active at a time).

How do attached processors work? Since there is already a permanent bus master in the system, the attached processor powers up in the idle or hold state. And when the appropriate software enables the attached CPU, the card takes over the bus as a temporary bus master. This allows the new CPU to share all the same memory and I/O cards that are already in the system. This can be a very cost-effective way of adding a new CPU since very little logic is required on the boards. It assumes, of course, that the original system's

CPU TYPE	PERMANENT BUS MASTER	TEMPORARY BUS MASTER	ON-BOARD RAM/EPROM AND I/O	SUPPORTS DMA	NUMBER OF ACTIVE CPUS
Dual	Yes	No	No	Yes	1
Attached	No	Yes	No	No	1
Slave	No	No	Yes	Yes	No limit
Coprocessor	No	Yes	Yes	Yes	16

Table 1. *Comparative features of the various multiple-CPU schemes discussed.*

memory and I/O will work with the new CPU at its new clock speeds.

Attached processors have one disadvantage, they work only as temporary bus masters. As long as the attached processor is enabled, the bus is allocated to it and no other DMA (Direct Memory Access) device can gain access to the bus. This means that all floppy and hard disk activity has to be controlled by the permanent bus master instead of the attached processor. Depending upon the system, the software to do these tasks may be easier done on the permanent bus master anyway.

THE SLAVE PROCESSOR

As memory technology advanced, it soon became possible to design cards that not only contained a Z80 CPU chip but also 64K bytes of RAM and I/O. The first highly integrated cards like these were essentially single board computers that could drive the S-100 bus. These designs were intended to be used as the main processor, however, and only one card per system was allowed.

Then someone got smart. It was realized that a very powerful multiuser system could be built that did not slow down as more users were added to the system. This was accomplished by giving each user his own CPU with its own full complement of RAM and terminal I/O. The only shared resources are disks, printers, and modems. If it became necessary to add another user to the system, another combined CPU-RAM-I/O card could be added for that new user. These systems never suffer

the impact of adding another user, unless everybody on the system is compiling programs using the hard disk. Multiuser systems of this type are very cost effective.

Typically, these systems run under TurboDOS and the type of CPU cards they use are called *Slave Processors*. The first TurboDOS slave processors were Z80 cards and ran CP/M-type programs in multiuser systems. Today most TurboDOS systems use 8086-compatible CPU cards and can also run MS-DOS programs.

Regardless of CPU type, all slave processor cards have the same architecture. Besides the CPU, they each have local RAM and EPROM accessible by the on-board CPU, at least one serial port, and a host communication port. The reasons for the CPU, RAM, and I/O are to give each user his own dedicated processor system. The host communication port is to permit each slave processor to make requests and receive data from the main system CPU and the disk drives.

Since all disk data passes thru the host communication port, performance concerns become a problem on high user count systems. A bottleneck occurs because disk data is transferred twice on the bus, once by the disk controller and once to get the data to the slave processor. Some slave processor designs solve this problem by allowing a portion or window of the on-board RAM to be accessed over the bus. Now a DMA device, like a hard disk, can transfer data once over the bus directly to the slave processor's memory. This not only frees the bus for other activity but also frees the host processor for more useful

work. The drawback of these designs is usually a higher cost due to the need of dual-ported RAM.

Slave processors also contain the added feature of being hardware reset by a master-CPU I/O write. This allows slave processors that have 'crashed' to be reinitialized without the need to reset and reboot the entire system.

Over the years, improvements and density have increased to the point that multiple slave processors are now available on a single card. Most of these designs are based on the Hitachi 64180 CPU chip. The 64180 is a super Z80 with support for up to 512K of DRAM and on-chip serial ports and DMA capability. This highly integrated device allows room for 2 to 4 slave processors per S-100 card, enabling very high user count systems to be built.

THE COPROCESSOR

A Coprocessor is to most people a hardware floating-point math calculator. This is true for those devices that attach directly to many of the CPU chips available today. But, architecturally, what is a coprocessor in a system? A coprocessor is a device that performs its task in parallel with the host processor and has direct access to any and all resources that the host processor has access to. Essentially, a coprocessor is a slave processor that can read or write to any device found on the system bus.

A coprocessor accesses devices (RAM or I/O) found on the S-100 bus by looking like a DMA device, cycle stealing data transfers away from the host processor. The multiple bus master arbitration capabilities of the S-100 bus are utilized in these designs. This method is very powerful but limits the maximum number of coprocessors to 16. Considering that most chassis are limited to 20 slots, this maximum number is probably never reached before there are no more card slots.

The major advantage of coprocessors is their flexibility. Since they can do anything the host processor can do (in the way of accessing bus data), they can talk to the peripherals, like disk drives, without bothering the host processor. This can be a very important feature for software develop-

ment systems where the coprocessor is acting out the role of a final main processor. The coprocessor architecture also allows multiple-card implementations of a desired function since the coprocessor can extend its influence over whatever peripherals it needs. A slave processor can't do this.

The major disadvantage of coprocessors is cost. It takes a lot of logic to support the ability of a card to access the bus like a DMA device.

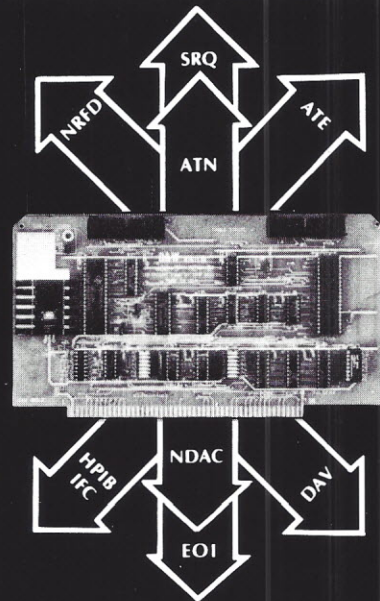
CONCLUSION

Table 1 shows a summary of features and differences between the various multiple-CPU schemes discussed. It is difficult to say which approach is the best. It all depends upon your system, your needs, and the software you have. Keep in mind that slave and coprocessor designs will typically stand the test of time longer and are generally more compatible. This is because of their bus independence afforded by their on-board RAM/EPROM and I/O.

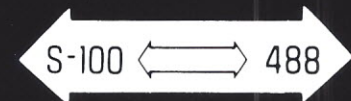
Slave and coprocessors are good cards to use for speeding up old systems too. I originally designed and debugged a 10-MHz 68000 coprocessor in a 2-MHz 8080 Altair system. Since the 68000 had its own local RAM, it was capable of running at its full speed regardless of the speed of the system bus. And when I upgraded to a 6/8-MHz dual 8085/88 host CPU card in a CompuPro chassis, the 68000 coprocessor card transferred over to the new system and ran just fine.

I have received a number of questions concerning the IEEE-696 compatibility of the Zenith Z-100 systems. Before I can answer these questions, I need to examine documentation with schematics and any theory of operation on the Z-100. If there are any readers who have or know how to get this information, please write to me at the address found at the beginning of this article or give me a call at (408) 253-5108.

Don Pannell



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MOVE YOUR TPA

Jay Vilhena

Survey results indicate that the 68000 is a popular chip with *S-100 Journal* readers, so hopefully at least some of what I dig up for this column should be of interest to several of you. Also, I am offering a 68000 T-shirt plus 20 name brand diskettes (Maxell, 3M, Dysan — you pick size and format) for all 'great' reader contributions (hints, programs, techniques, news, etc.) that I publish in this column. You don't need to write an article, simply tell me about it. If your contribution is not judged 'great,' but I still publish it, you still get the T-shirt.

Anything that relates to the 68000 is of interest for this column. That could be hardware, but it could also be material for or about UNIX, OS-9, CP/M-68K, THEOS, d/OS, or other operating systems running on the 68000. Let's hear what goodies you have to share.

In addition, if you have a commercial product that might be of interest to 68000 users, tell me about it. I won't give you any disks or T-shirt for the information, but I will publish a few paragraphs about your product if it seems that it is indeed an interesting one.

And, the exciting product this time is a book. It is called *68000 Microcomputer Systems: Designing and Troubleshooting*, by Alan D. Wilcox, and published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. The book is intended as a text book for a university course (those of you teaching microcomputer design courses should take a look at it). It not only tells you all that you need to know to interface to the 68000, it also tells you all that you need to know to

MOVETPA.S LISTING

PROGRAM WRITTEN BY DON PANNELL

```
*file: movetpa.s      CP/M-68K TPA relocation program - version 1.0
*last modified:      9/19/87      by: Don Pannell, Peak Electronics
*
start:
    move.w #9,d0          *d0=code to display a message
    move.l #startmsg,d1   *d1=address of the message to display
    trap #2               *display the message
    bra gettpa            *branch around signon message text
*
startmsg:
    dc.b cr,lf,'Peak Electronics CP/M-68K TPA Relocation program.'
    dc.b cr,lf,'Program Version 1.0 - Copyright (C) 1987'
    dc.b cr,lf,lf,'The old TPA start address = $'
*
htpmsg:
    dc.b cr,lf,'          & its end address = $'
    even                    *assure next op is word aligned
*
*****
*      read & display the current TPA values
*****
gettpa:
    move.w #63,d0          *d0=code to get/set TPA limits
    move.l #tpab,d1        *d1=address of the TPA parameter block
    clr.w tpab             *set parameter word to GET TPA limits
    trap #2               *execute the BDOS get TPA limits
*
    move.l tpab+2,d2       *d2=low TPA address
    bsr longout            *display this systems low TPA address
    move.w #9,d0          *d0=code to display a message
    move.l #htpmsg,d1      *d1=address of the high tpa msg
    trap #2               *display the message
    move.l tpab+6,d2       *d2=high TPA address + 1
    sub.l #1,d2            *adjust out the + 1
    bsr longout            *display this systems high TPA address
*
*****
*      decode the NEW TPA values
*****
    move.l tpab+2,d0       *d0=the current low TPA address
    add.l #81,d0           *d0=start of command line parameter string
    move.l d0,bufpt        *store adjusted value in the buffer pointer loc
    move.l #bufpt,a2       *setup a2=addr of the buffer ptr for as2hx
    bsr as2hx              *convert 1st command parm to hex
    bne showsintax         *if a conversion problem display help msg
    move.l d2,d4           *save 1st parameter in d4
    bsr as2hx              *convert 2nd command parm to hex
    bne showsintax         *if a conversion problem display help msg
    move.l d2,d3           *save 2nd parameter in d3
    move.l #badparmmmsg,d1 *d1=start of bad parameter message
    sub.l d4,d2            *d2=d2-d4 (2nd parm - 1 parm)
    blo showsintax         *show err if requested tpa is too small
    sub.l #54000,d2        *d2=d2-minimum tpa size
    blo showsintax         *show err if requested tpa is too small
    bra setnewvals        *progress if have good input data
*
badparmmmsg:
    dc.b cr,lf,lf,'==> The requested TPA size is less than the '
    dc.b '16K minimum.$'
```



```

even                *assure next op is word aligned
*
showsyntax:
    move.w #9,d0      *d0=code to display a message
    trap #2           *display error message passed in d1
    move.w #9,d0      *d0=code to display a message
    move.l #syntaxmsg,d1 *d1=address of message to display
    trap #2           *display proper syntax message
*
    rts              *return to the CCP
*
syntaxmsg:
    dc.b cr,lf,lf,'For proper TPA relocation, this program requires the'
    dc.b cr,lf,'new TPA start address and new TPA end address to appear'
    dc.b cr,lf,'on the command line right after this programs name.'
    dc.b cr,lf,lf,'For example: MOVETPA 100000 1fffff',cr,lf,'$'
    even              *assure next op is word aligned
*
*****
*               set the NEW TPA values
*****
setnewvals:
    move.l d4,tpab+2  *store 1st parm as low TPA address
    move.l d3,tpab+6  *store 2nd parm as high TPA address
    add.l #1,tpab+6   *adj high TPA addr value for BDOS call
    move.w #53,tpab   *set function to permanently set TPA limits
    move.w #63,d0     *d0=function to get/set TPA limits
    move.l #tpab,d1   *d1=address of the TPA parameter block
    trap #2           *set the new TPA limits
*
*****
*               display the NEW TPA values
*****
    move.w #9,d0      *d0=code to display a message
    move.l #newtpamsg,d1 *d1=address of the new TPA low addr message
    trap #2           *display the message
    move.l d4,d2      *d2=address value to display (low addr)
    bsr longout       *display the low addr value
*
    move.w #9,d0      *d0=code to display a message
    move.l #hnewmsg,d1 *d1=address of the new TPA high addr message
    trap #2           *display the message
    move.l d3,d2      *d2=address value to display (high addr)
    bsr longout       *display the high addr value
    bra progend       *all is done, end the program
*
newtpamsg:
    dc.b cr,lf,lf,'The NEW TPA start address = $'
hnewmsg:
    dc.b cr,lf,'      & its end address = $'
    even              *assure next op is word aligned
*
*****
*               Normal End of Program
*****
progend:
    move.w #9,d0      *d0=code to display a message
    move.l #endmsg,d1 *d1=address of the end message
    trap #2           *display the message
*
    rts              *return to the CCP
*
endmsg:
    dc.b cr,lf,lf,'Normal End of Program',cr,lf,'$'
    even              *assure next op is word aligned
*
*
*
*****
*               subroutine: crlf
*               This routine is used to display a <cr> followed by a <lf>.
*               input: nothing
*               output: nothing
*               effect: nothing destroyed
*****
crlf:
    move.w d0,-(a7)    *save reg d0
    move.l d1,-(a7)    *save reg d1
    move.w #9,d0      *d0=code to display a message
    move.l #crlfmsg,d1 *d1=address of the cr lf message
    trap #2           *start a new line
    move.l (a7)+,d1     *restore d1
    move.w (a7)+,d0     *restore d0
    rts              *done
*
crlfmsg:
    dc.b cr,lf,'$'
    even              *insure next op is word aligned
*

```

interface to *the S-100 bus*. More, it completely covers the design of a 68000 S-100 CPU board, guiding the reader through the design techniques, construction, and testing stages. Then it describes interfacing to and design of memory and I/O. Finally, it describes testing software and how to run the board with CP/M-68K. Both advanced electrical engineering students and practicing engineers getting into 68000 and IEEE-696 bus design will find this 580-page book a tremendous source of information.

Alan D. Wilcox is an associate professor of Electrical Engineering at Bucknell University, and he uses his 68000/S-100 book as a basis for the microcomputer design courses that he teaches. Dr. Wilcox can be contacted at 60 South 8th St, Lewisburg, PA 17837, (717) 523-0777.

Another exciting product is a 68000 operating system that you can buy for \$50 and supports MS-DOS disk formats. It is called K-OS ONE and can be obtained from Hawthorne Technology, 8836 SE Stark, Portland, OR 97216, (503) 254-2005. I hear that several users have this operating system configured for some 68000 S-100 systems, but I don't know who. Let me know if you do. It is claimed that K-OS ONE is very easy to implement on any 68000 system. They also have an Assembler and the HTPL language for it. HTPL is a proprietary Modula2-like, Forth-like language. Forth is also available and C and BASIC are in the works. Hawthorne Technologies publishes a regular newsletter, *68-Knews* (I don't know if you pronounce the K or not), that supports K-OS ONE. Give them a call; just being able to read MS-DOS disks on your 68000 is worth the 50 bucks. I'll tell you more when I find someone (remember the 20 disks and T-shirt) that will send me some drivers for the CompuPro 68K CPU and Disk 1 or 1A. Unfortunately, I don't have the time to sit down and figure out how to write them myself.

And, last but by no means least, here is the sister program for the Memory Tester that I gave you last time. This one is also written by Don Pannell, our knowledgeable technical editor, and, yes, he gets the 20 disks and T-shirt. (*How many T-shirts do you really need Don?*)

This program is called MOVETPA,

and I'll tell you in a minute what it does. Suppose that you bought your 68K system with CP/M-68K preconfigured for, say, 128K or 256K of memory, as most people did. Now you decide that you really want 1, 2, or even all 16 Megabytes, so what do you do? (Besides cashing out for the extra RAM boards, that is.) You may or may not have the source code for the BIOS, and that is what you need to change to make your system recognize the extra memory. The BIOS change is actually not that difficult if you're into that sort of thing, but if you don't have the source code, there's not much you can do anyway. Unless you have MOVETPA.

MOVETPA is a fast program that takes as long to execute as it takes to write ten lines on the console. *It literally moves your TPA area to any location in memory that you tell it to.* Your Transient Program Area (TPA) is the region of memory that is available for your application programs' use. In a 256K CP/M-68K system, you have a little over 200K of TPA memory. If you expand your system memory to 1 Megabyte, MOVETPA can move your TPA to the area between 256K and 1024K so that now you can have 768K of applications memory. All this without touching the BIOS whatsoever.

First you need to assemble the source listings published here; in the last column, I described how to do that if you don't know. Or, you may want to simply order a disk from Don (see his address on page 21) with the program on it, ready to run. For \$15, he'll send you this program plus the memory-tester program of the last issue, both complete with source code.

Once you have the program as a MOVETPA.REL file, simply type

MOVETPA.REL 40000 FFFFF

to move your TPA to between 256K and 1 Megabyte (Note: 1 Megabyte is 1024K which is 1024×1024 bytes which is FFFFF+1 in hexadecimal. Most of you probably know how to convert and manipulate the addresses, but if you don't, and you're mixed up, give me a call). For whatever memory area you need to move your TPA to, simply enter the first parameter as the starting memory address in hex and the second

```
*****
*      subroutine: longout
*      This routine converts the data found in register d2 to ASCII
* and sends it out to the console. A single space is appended to the
* end (i.e., 9 bytes of data are sent out).
* input: d2.l=value to send
* output: ASCII value sent out
* effect: nothing destroyed
*****
longout:
    move.w d7,-(a7)      *save register d7
    move.w #8-l,d7       *init d7 to loop for 8 characters
loop:
    rol.l #4,d2          *place MSN to LSN
    bsr hx2as           *convert and output d0's LSN
    dbra d7,loop        *see if done
*
    bsr blankout        *append a space
    move.w (a7)+,d7     *restore register d7
    rts                *done
*
*****
*      subroutine: as2hx
*      This routine reads in the next value found in an input
* buffer and converts it to hex (binary). The address of the
* buffer's buffer pointer is passed in register a2. The result
* is returned in d1. If an illegal hex character is found
* or the converted value exceeds 32 bits in size, the routine
* returns an error (z is reset) with reg a0 pointing to the
* error message. The conversion terminating characters are:
* null, comma, semi-colon, and trailing spaces. Leading
* spaces are ignored.
* input: a2.l=address of input buffer's buffer pointer
* output: d2.l=converted value
*        d1.l=address of error message if z is reset
*        z is reset if an error occurred
* effect: a0.l, a1.l, d0.l, d1.l, d2.l & d3.w destroyed
*****
as2hx:
    clr.l d2            *clear the result value
    clr.w d3            *clear the leading space ignore flag
hex:
    move.l (a2),a1      *a1=addr of current char in buffer
    clr.l d0            *clear the entire destination reg
    move.b (a1)+,d0     *read the next char
    beg hexen           *end routine if null (cr) reached
    cmp.b #',d0         *is char a semi-colon?
    beg hexen           *if so, end routine w/out buffer bump
    move.l a1,(a2)      *restore the bumped buffer pointer
    cmp.b #' ',d0       *is char a space?
    beg hexspace        *if so, check what to do w/the space
    move.b d0,d3        *set d3 to value of char to set space flag
    cmp.b #',d0         *is char a comma?
    beg hexen           *if so, end the routine
    move.l #illhex,d1   *dl=illegal hex char err msg
    sub.b #'0',d0       *convert ascii to binary (0 to 9)
    bmi hexen           *if result is neg, return err
    cmp.b #09,d0        *is result < a 9?
    ble adhex           *if so, add in this value
    sub.b #07,d0        *convert letter hex to binary (a to f)
    cmp.b #0a,d0        *is result < an a?
    blt hexen           *if so, return err
    cmp.b #0f,d0        *is result > an f?
    bgt hexen           *if so, return err
adhex:
    move.l #illnum,d1   *dl=hex overflow err msg
    cmp.l #0ffffff,d2   *is current value > 0ffffff?
    bgt hexen           *if so, return err
    rol.l #04,d2        *current val = current val * 16
    add.l d0,d2         *current val = current val + new
    bra hex            *get the next char
hexspace:
    tst.w d3           *are leading spaces being processed?
    beg hex            *if so, ignore the char
    clr.w d3           *else, set z and end using space as terminator
hexen:
    rts                *return w/z set or reset
*
illhex:
    dc.b cr,lf,lf,'===> Illegal hex character found.$'
illnum:
    dc.b cr,lf,lf,'===> Hex conversion overflow error - # too large.$'
    even
    *
    *
```



```

*****
*      subroutine:  hx2as
*      This routine converts the LSN in d2 to ASCII and sends it
* to the console.
*      input: LSN of d0=value to convert and send out
*      output: value converted and sent
*      effect: nothing destroyed
*****
hx2as:
    move.w d2,-(a7)      *save register d2
    and.b  #$0f,d2      *mask out MSN of d2's LSW
    or.b   #$30,d2      *convert to ASCII (0 to 9)
    cmp.b  #'9',d2      *is result <= 9?
    ble    spfix        *if so, skip the letter fix
    add.b  #$07,d2      *else, convert to ASCII (A to F)
spfix:
    bsr    consoleout   *output d2 to the console
    move.w (a7)+,d2     *restore register d2
    rts                    *done
*
*****
*      subroutine:  blankout
*      This routine is used to display a single SPACE character to
* the console.
*      input: nothing
*      output: ASCII space sent out
*      effect: nothing destroyed
*****
blankout:
    move.w d2,-(a7)      *save register d2
    move.b #' ',d2      *set d2.b to char value to send
    bsr    consoleout   *output the space
    move.w (a7)+,d2     *restore d2
    rts                    *done
*
*****
*      subroutine:  consoleout
*      This routine is used to display the byte value found in reg
* d2 to the console.
*      input: d2.b=character to send to the console
*      output: character sent
*      effect: nothing destroyed
*****
consoleout:
    move.w d0,-(a7)      *save register d0
    move.w d1,-(a7)      *save register d1
    clr.w  d1            *insure MSB of target reg is zero
    move.w #2,d0         *d0=code to do console output
    move.b d2,d1         *d1=byte value to output
    trap   #2            *perform the console output
    move.w (a7)+,d1      *restore register d1
    move.w (a7)+,d0      *restore register d0
    rts                    *done
*
*****
*      start of Block Storage Segment
*****
bss                    *start the block storage segment
tpab:
    ds     5            *reserve 5 words for the TPA parm block
bufpt:
    ds     2            *reserve 2 words for the input buffer pointer
*
*****
*      EQU's
*****
cr      equ    $0d
lf      equ    $0a
esc     equ    $1b
*
end                        *end of movetpa.s

```

— END OF MOVETPA.S LISTING —

parameter as the ending address. That's all there is to using the MOVETPA program.

There is a potential problem: If you received your CP/M-68K files as PIP.68K, STAT.68K, etc. instead of PIP.REL, STAT.REL, etc., these files are bound to your original TPA location and they will not work in your new TPA area. There is only one solution: You must get those .REL files and RELOCate them after you've moved your TPA. If whoever sold you your CP/M-68K system does not come up with .REL files for you, complain loud. Remember to also RELOCate all your programs that were previously RELOCated in your old TPA. Finally, find some automatic means of running MOVETPA after you turn on or reset your machine. If you have a batch file that automatically executes on cold boot, simply stick the program there. Then sit back and enjoy your new, large memory space.

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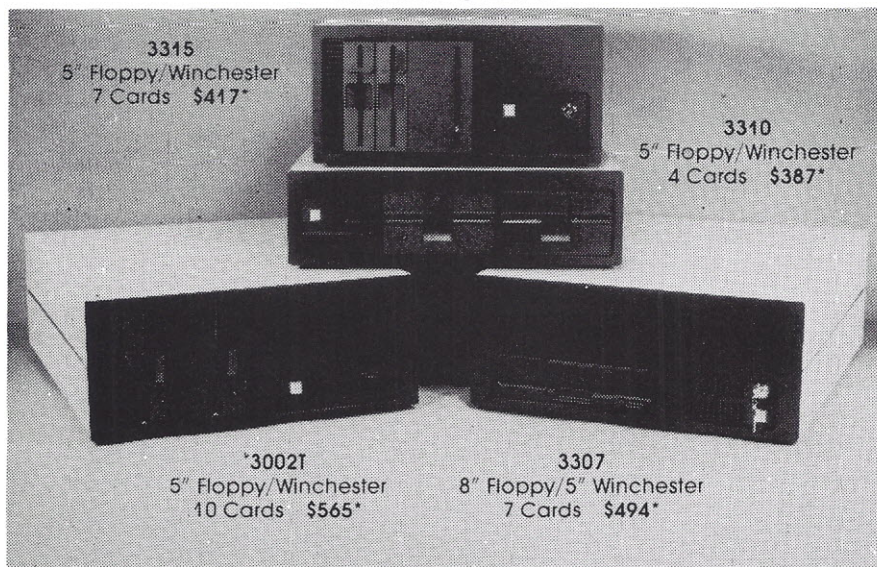
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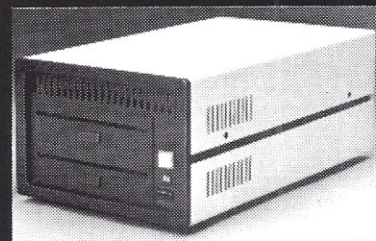
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ADD PERFORMANCE WITH PARALLEL PROCESSORS

Frederick D. Davis

For years, the S-100 bus has been an ideal multiple-CPU environment. Multiple slave processor boards have commonly been implemented under TurboDOS to increase the number of users without affecting system performance. Another trend, now becoming popular in Concurrent DOS systems, is to add coprocessor boards (usually known as satellite processors) to increase both the number of users and the number and speed of applications running concurrently.

Typically, satellite processors carry on-board memory and bring two key benefits that are application dependent:

1. They increase the amount of memory available to a single process and to a system.
2. They increase the aggregate CPU power available on a system.

One or both of these benefits may be realized for a given application. Increases in speed are generally not too significant for applications that are disk or I/O intensive, but one or more coprocessors may nevertheless be justifiable because they allow more users on a system.

Satellite processors also bring another potential benefit that is in-

dependent of their application environment. Since they offload programs to their own local memory, satellites free up the system's main memory. This means that features can be added to the operating system without reducing the number of users or the size of programs that it can support. A megabyte, feature-laden operating system becomes feasible.

Overall system throughput could be dramatically enhanced through the addition of more sophisticated algorithms for handling disk and terminal I/O, the two areas which, with the arrival of satellite processing, will become the dominant performance bottleneck of S-100 systems.

To get a better idea of what satellite boards can do, let's look at a specific board, Vision's GPS-286, as an example. Drivers supplied with this board are for running with Concurrent DOS.

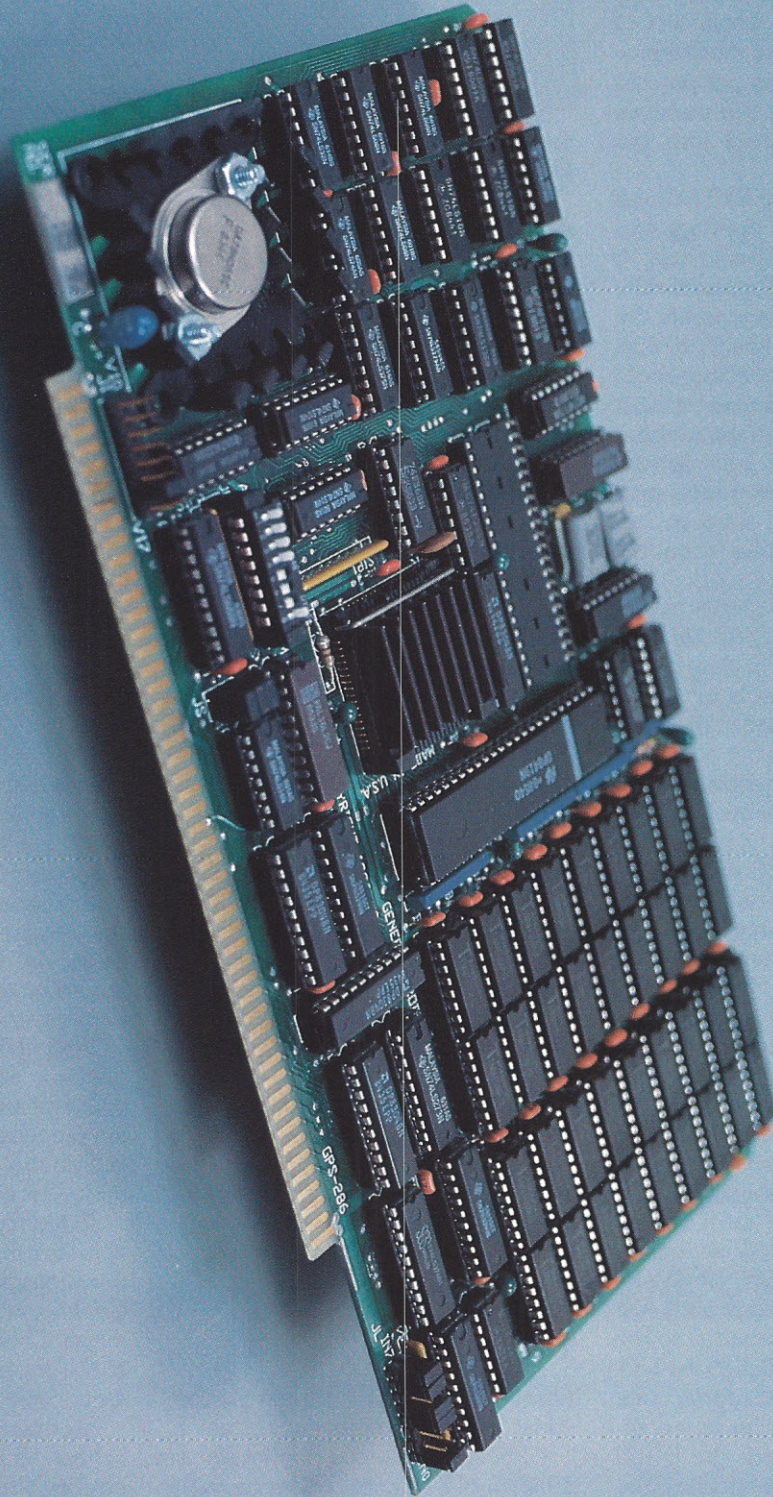
VISION GPS-286

The Vision GPS-286 Satellite Processor board is offered independently of any base hardware system or specific version of Concurrent DOS. It has an 8-MHz 80286 processor on-board with 1 Megabyte of zero-wait-

state dynamic RAM. A 12-MHz zero-wait-state version is also available. An 80287 on-board coprocessor is optional, and the GPS-286 comes with a socket for it. Installation is straightforward. My first installation on a CompuPro system took me about 30 minutes and a call to the company. Installation examples in the board documentation were for CompuPro Concurrent DOS 4.11 and for Gifford Systems. The call to the company was necessary because documentation is somewhat scanty. My second installation, in an entirely different system, only took about ten minutes.

Up to eight satellite boards may, theoretically, be installed in a system, each board having a unique ID number that is set with three jumpers. The board ID number is then entered into an ASCII startup configuration file. Another board jumper determines the vector number. This comes preconfigured for the most common one, though in some circumstances you may need to change it. If it is changed, the new vector number must also be entered into the configuration file. ►

Fred Davis is a programmer and consultant in Riverton, Utah. He specializes in custom applications for multiuser systems.



*The GPS-286 Satellite
from Vision Computers*

Up to sixteen processes may run on each board. Since there is only 975K of available user memory per board, it is unlikely that you will actually run that many. This is an issue at installation time since you must determine and specify which system flags are to belong to the satellite processor system. One flag per process must be available. The flag numbers chosen are also entered into the configuration file.

CS, a replacement for SYSTAT, will allow you to examine the flags and determine those that are in use. If there are not enough flags available, then you will need to regenerate the system with more flags specified. Just remember, since we are talking about user processes, the number of flags does not need to exceed the number of virtual consoles in your system plus any detached background processes that you might want to run on a satellite board, plus a couple for good measure.

The final installation step is to run the supplied INSTALL.BAT file with your modifications. You can determine whether a process is to run by default on a satellite board or the main CPU. You may also select a specific satellite board for any particular program. Certain programs, mostly system utilities, that access I/O devices directly or CDOS system data areas must run only on the main CPU. All programs not specifically set for the main CPU will run, by default, on the satellite board. At execution time, a new command is recognized that allows the user to cause a program to execute on the main CPU or a specific satellite. If you have more than one satellite, tasks are assigned evenly among the boards, assuming sufficient memory is available.

Finally, several lines must be added to your SYSINIT.BAT file, one of which executes GPSMON. GPSMON is a detached background process that interfaces the satellite board(s) to the main processor. It handles all the I/O, i.e., disk, terminal, and printer, that the process on a satellite board requests. GPSMON asserts the S-100 line PHANTOM* and enables the memory on the satellite through the use of an I/O port address and then reads or writes through to the satellite.

The GPS-286 comes in two versions, one with an on-board voltage

NO GPSMON Sieve on 8088	GPSMON Sieve on 8088	GPS-286 Sieve on 286
78.00	86.15	25.37

Table 1. *Time of execution in seconds of the Sieve of Eratosthenes with 1. No GPSMON; 2. GPSMON active but no tasks on satellite; 3. Satellite active.*

regulator for most systems and one without a regulator for those systems with switching power supplies. While GPSMON and the GPS-286 allow addressing of up to eight satellites, the actual maximum could very well be determined by your power supply. The GPS-286 with a regulator uses about 2.5 amps with an 80287, and 2 amps without the math coprocessor.

TEST SYSTEMS

Test results are given here for running the GPS-286(s) in three different systems. My system (System 1) has the CompuPro 8085/8088 8-MHz dual CPU with 384K of static RAM running CDOS 3.1 with one physical and four virtual consoles. The second system (System 2) has the Macrotech MI-286 6-MHz CPU and 1 Megabyte of mixed RAM running the CCT modified CompuPro CDOS 4.1 generated with seven physical/virtual consoles. The third system (System 3) is a CompuPro with 768K of CompuPro static memory, a System Support card, two Interfacer 3 cards as terminal controllers, and thirteen serial terminals. The CPU is also a 6-MHz MI286 from Macrotech. System 3 has a SMD-WDC hard disk controller from Dual Systems and an 80-Megabyte CDC 9448 hard disk drive.

TESTS ON SYSTEM 1

One 8-MHz GPS-286 satellite was used for the benchmarks on System 1.

GPSMON takes a minimum of 10.45% of the main CPU processing time when no tasks are running on the satellite. The more processes are running on the board, the more main CPU overhead is taken. How much more depends upon the nature of the

tasks. GPSMON also requires a block of system memory for itself, about 160K in my installation.

I used a compiled CBASIC version of the prime-number generator Sieve of Eratosthenes program as a CPU-intensive task to measure the effect of various load conditions on the satellite board. All times given are in seconds for 100 iterations of the Sieve program. Each measurement was made three times and the average presented here. Table 1 shows the basic CPU performance when running the Sieve.

Not unexpectedly, an 80286 with the same clock speed and wait states as an 8088 is about three times as fast. The GPSMON program takes 10.45% off the main CPU performance in this setup in order to maintain contact with the one satellite board. Addition of the satellite, however, is very justified because of the considerable increase in execution speed of programs — by running them on the satellite — without requiring any other changes to an existing system.

Next, I wanted to see how the addition of the satellite board can compensate for the performance degradation (decline in execution speed) that occurs as more tasks are added to a multitasking system.

To test this, I increased the number of tasks running concurrently with the Sieve program. In one test I added a CPU-bound program and in another a non-CPU-bound program. In both cases, the programs were left waiting for console input while the Sieve ran.

For the non-CPU-bound program, I chose VEDIT, an editor from CompuView Products which is very efficient at releasing CPU overhead while waiting for console I/O. VEDIT was run concurrently on 1, 2, and 3 virtual consoles while the Sieve also ran on the fourth console.

The CPU-bound program is a custom program that uses DRI's Display Manager (this program will hereafter be referred to as DM) and which requires the constant supervision of the CPU while waiting for console I/O. Again the program ran concurrently on 1, 2, and 3 virtual consoles while the Sieve ran on the fourth.

Table 2 summarizes the results for running these tasks on the 8088 without the GPS-286 and for running the same tasks on the 286 satellite.

The results from Table 2 show that the execution times obtained while VEDIT is running remain basically the same as those obtained for the Sieve running alone (Table 1). Hence the addition of the 286 satellite shows no speed advantage for I/O-intensive, non-CPU-bound programs, in fact a minor amount of overhead is added. However for the CPU-bound DM, the results are dramatic. With the four tasks (one Sieve plus three DMs) executing on the main CPU alone (8088) execution times increased from 78.00 secs (Table 1) to 313.59 secs (Table 2), a performance degradation of over 400%. But with the satellite running, the performance degradation was a mere 4.3% (from 25.37 seconds to 27.76 seconds). These results are so drastic also because GPSMON adds a layer of intelligence between the request for input from the inefficient DM program and the actual request to the operating system for input.

Thus, from the tests on System 1 we can conclude that the addition of

a satellite board can considerably increase the performance of a multi-tasking system, particularly when running CPU-intensive applications.

TESTS ON SYSTEM 2

System 2 is installed at a business that uses a custom program intensively all day every day. That program also was written using Display Manager. Typically three to six people use the program at the same time. At certain kinds of input fields, menu choices, and entry screen command input, non-DM input routines were used in order to allow a 'safe' place to leave the screen inactive without impinging upon performance of the system.

With the addition of a GPS-286, the running of reports that are disk and CPU-intensive typically ran in about one third of usual time. The perceived improvement in the data input screens and screen displayed queries was somewhat less.

The terminals were communicating at only 9600 baud. This puts a cap on how fast a screen could actually be displayed. If full speed had already been reached, then even if the computer could squirt out the characters three times as fast, the terminal couldn't receive and display them any faster.

When reports, work orders, and invoices were being printed, output speed could, at times, be limited by printer speed and/or disk access. When two or more processes are contending for the disk,

faster CPU processing won't increase the perceived speed if a process is waiting for the disk. The reports of perceived improvement varied tremendously from person to person and time to time. The range was from little, if any improvement, to large improvements. Generally, the more users on the system, the more the relative improvement.

TESTS ON SYSTEM 3

System 3 is at Vision Computers. They tested the GPS-286 for multi-user performance, and these are their benchmarks.

Three sets of benchmarks were run that illustrate three classes of application environments:

1. Heavy disk and terminal I/O (DataFlex Record Review).
2. Moderate disk and terminal I/O (DataFlex Compile).
3. CPU intensive (CPU Test).

It is important to distinguish among these classes because the GPS-286 satellite processor uses the system's main CPU to handle disk and terminal I/O. This can limit the impact which the GPS-286 can have on certain applications.

All three benchmarks were run on four system configurations using the main CPU only, and one, two, and three GPS-286 satellite processors.

The DataFlex Record Review benchmark is both disk and terminal I/O intensive. It uses a special automated input utility to enter the "Next Record" key, which causes DataFlex to advance sequentially through a data file, displaying each record as it proceeds. A total of 91 records are examined. Seven sets of benchmarks were run, ranging from one to seven users.

The DataFlex Compile benchmark represents a balance among CPU, terminal, and disk activity. It uses the DataFlex compiler to compile the MENUDEF.FRM program that is part of the standard DataFlex package. It is evoked on each terminal by the command line:

COMP MENUDEF.FRM;

Twelve sets of benchmarks were run, ranging from one to twelve users.

The CPU Test benchmark is a CPU-intensive program written in as-

NO. VIRTUAL CONSOLES RUNNING (besides Sieve)	SIEVE WITH VEDIT		SIEVE WITH DM	
	8088	286	8088	286
1	78.00	25.47	156.86	26.17
2	78.00	25.58	235.41	26.98
3	78.01	25.65	313.59	27.76

Table 2. Times of execution in seconds of the Sieve running concurrently with other programs, 1. VEDIT; 2. DM. The 8088 results were obtained with the tasks running on the main CPU without the 286 satellite. The 286 results were obtained with the tasks running on the satellite.

sembly language. It performs about 8 million loops using the following code:

```
MOV DX,80H
L: MOV CX,FFFFH
LOOP$
DEC DX
JNZ L
MOV CL, 0
INT 0E0H
```

Twelve sets of benchmarks were run, ranging from one to twelve users. The results are summarized on Table 3 and are discussed next.

Due to the high level of terminal and disk activity involved by the DataFlex Record Review benchmark, there was relatively little difference between running three programs on the same satellite (64 seconds per program) or running one program each on three different satellites (53 seconds each). This performance increase of only 17% suggests that the processors are spending most of their time idle, waiting for the completion of I/O. As previously mentioned, for this application the advantage of using satellite processors is simply one of capacity — more users can be

supported. In order to support seven users, two satellite processors could deliver virtually the same performance as three satellites.

The DataFlex Compiler benchmark showed significant performance improvement between one satellite running three programs (177 seconds) and three satellites running three programs (100 seconds). The reduction in run time of 43% shows that the processors spend some time idle, waiting for I/O (if the processors were completely utilized, the reduction should have been 67%). In this case, two satellites could deliver significantly more performance than one, but performance improvements level off by the time a third processor is added.

The CPU test program is entirely CPU intensive, and its results show linear improvement as satellites are added. Twelve users running on three processors run three times faster per user than twelve users running on one processor. For CPU-intensive applications, major advantages in both performance and capacity (number of users supported) can be realized by adding more satellites.

OTHER IMPLICATIONS

Since I/O is handled by the main CPU, a large amount of overhead and memory shuffling takes place while transferring data to and from the board. Whether or not this is advantageous depends on how much code is executed in the processing steps. In most user programs, this would far outweigh the overhead involved in data transfers to and from the board. One type of program that may be best off on the main processor is the background file server, such as Access Manager.

The GPS-286 requires your system to have CompuPro compatibility on two counts. The interrupt controller must have the same port address as CompuPro hardware. Second, I/O ports 040h-047h must not be used by anything else in the system. If both of these conditions are met, then the GPS-286 satellite board ought to work in your system. Obviously, all possible systems and operating system versions have not been tested. I would recommend that you

BENCHMARK	BOARDS IN SYSTEM	NUMBER OF USERS											
		1	2	3	4	5	6	7	8	9	10	11	12
DATAFLEX RECORD REVIEW	MI-286 only	33	54	82	110								
	1 GPS-286	30	43	65	82	102	123						
	2 GPS-286	30	42	56/61	76	94/100	120	134/145					
	3 GPS-286	30	40	56	68/76	94/100	120	132/144					
DATAFLEX COMPILE OF MENUDEF.FRM	MI-286 only	91	184	275	367								
	1 GPS-286	69	123	177	237	296							
	2 GPS-286	69	81	84/126	139	141/194	207	215/255	285	287/341	362		
	3 GPS-286	72	83	100	96/144	117/163	191	200/230	215/244	284	300/323	314/355	394
CPU TEST	MI-286 only	17	34	51	68	85	102	119					
	1 GPS-286	13	26	39	52	65	78	91					
	2 GPS-286	13	13	13/26	26	26/39	39	39/54					
	3 GPS-286	13	13	13	13/26	13/26	26	26/39					

Table 3. GPS-286 benchmarks. The benchmark results show the average execution time per terminal in seconds. In cases where some satellite processors ran more programs than other satellites for the same test period (as when three programs are divided between two satellites), the high and low average execution times are given.

arrange with your dealer that the sale of the board is dependent on successful installation; fortunately, my feeling is that the people at Vision are very cooperative in offering support for installing the board.

SATELLITE PROCESSORS AND THE FUTURE

I think that the future of S-100 multiuser computing is with multiple parallel processors. They represent one efficient way to approach the need for higher performance. Many mini and mainframe makers have used this technique to increase their processing power.

One interesting aspect of satellite processors is that they do not need to be identical. The principle can be expanded to allow running a variety of chips and on-board operating systems. There are satellite processors that handle their own terminals as well as those that don't. There are

also specialized coprocessors that do nothing but handle multiple RS-232 ports for terminals, printers, and modems.

The advantages of boards like the GPS-286 are that the slave board goes off and does its own processing, in its own memory, at its own speed, and only interacts with the main CPU when it needs system resources. The vast majority of memory accesses are off bus, allowing the satellites to run without the need to share the bus with transfers for other programs. This solution works well as long as you don't need to apply all of your power to one gigantic problem. Most businesses need to service many users with many programs at the same time. While there are some bottlenecks, under normal business use these would normally not be severe.

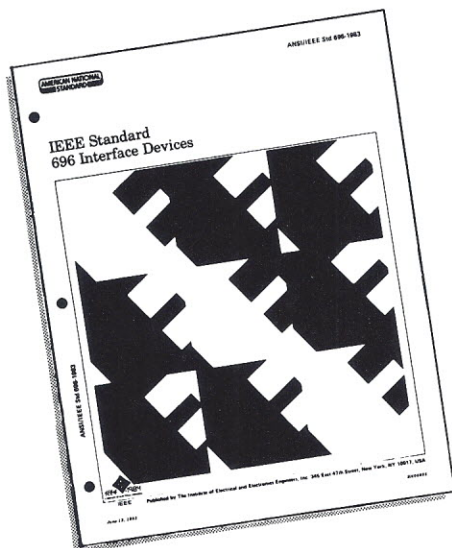
Furthermore, many of the bottlenecks can be cleared up with improvements in hardware and operating systems, multimegabyte hard disk cache buffers, faster hard

disks, and interfaces and Message Passing Coprocessors (MPC). The MPCs speed up the passing of information between processors. They are quite new and have not yet been implemented in the S-100 bus.

A year or three from now, a Super 696-32 system containing an 80386 running at 25 MHz on a 32-bit bus, with eight 25-MHz 80386 satellites using MPCs and several Megabytes on each board, could easily be supporting dozens of users with more performance than, and at a fraction of the cost of, traditional mini or mainframe computers. Add a Gigabyte or two of 16ms hard disk on a 4-Megabyte/sec high performance SCSI interface, and you have a system that will be 'micro' only in name and price. The future looks better than ever for S-100.

For more information on the GPS-286, please contact Vision Computers, 2235 Melvin Road, Oakland, CA 94602, (415) 530-2390. They also offer other satellites and complete CompuPro and Macrotech-based systems.

Now Available from S-100 Journal: IEEE Standard 696 Interface Devices



This is the official booklet published by The Institute of Electrical and Electronic Engineers, Inc. It describes in technical detail the IEEE-696 standard or, in other words, the complete specs for the operation of and interfacing to the S-100 bus. All the bus lines and their relationships are described in detail. (Note: this book is not a tutorial.)

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CI'S POPPYII: EGA GRAPHICS ON THE S-100 BUS

Jay Vilhena

Imagine dropping a new S-100 board into your current system, connecting a color monitor and keyboard to it, installing the supplied software drivers, and pronto, now you can run all MS-DOS software, including EGA color graphics on your S-100, *without any changes whatsoever to your existing hardware*. Fantasy? Not really, it exists and it's called PoppyII from Charter Information Corp (CI).

COMPATIBILITY COMES OF AGE

There was a time when the S-100 bus was popular, very popular. Then came the IBM-PC, and not only the S-100 but also many other high-performance systems were either bumped off the market or relegated to usage by only a small minority of users who did not accept that they should dispose of a professional system to replace it with a toy. But indeed there was one reason why they should: *Software!* However we feel about PCs, MS-DOS application software represents a historic revolution. Never before have so many powerful productivity tools been available for so

little investment. Desktop publishing is probably the best known of the new computer-made-possible sciences, but the fact is that essentially all areas of knowledge and production have been profoundly affected.

Only the huge acceptance of MS-DOS as an operating system made

the software explosion possible. Now it became worthwhile to invest gigantic amounts of software development time because there was a market large enough to pay for it. Had the industry been more equally divided between a dozen incompatible operating systems, large investments in software

WILL THE POPPY RUN WITH YOUR OS?

At the beginning of this article, I state that the PoppyII can be dropped in your system and run. That is in fact true if your host Operating System is TurboDOS version 1.43 or later *and* your master CPU is an ICM board. To run with a different master, even under TurboDOS, it requires a little more elaborate technical fumbling which I suspect is beyond most users' knowledge. To run under a different OS, there aren't any drivers.

However, Charter Information not surprisingly wants to make its board available to every possible S-100 user. They have been actively contacting all possible S-100 companies to try to get them to support the board in their software. From a hardware point of view, the board can work in any system.

If you want to buy one or more Poppys for your non-TurboDOS, non-ICM system, there are two things you can do:

1) Write to the S-100 company that sells your OS/Disk Controller system — or in the case of a defunct company to whoever might service your system, see our S-100 Directory for a few of these — and tell them that you want to buy the PoppyII board and you want them to offer it packaged with drivers for their own hardware/software. 2) Write Charter Information and tell them also that you are ready to buy their board(s) as soon as drivers for your XYZ system are available. If enough of you do this, I suspect you'll have a board ready to drop in your system sooner than you might expect.

Finally, if you are an OEM or a programmer who thinks that you can write the drivers for a different OS, e.g., Concurrent DOS, then do it and sell the rights to CI or offer the software for sale — we'll tell about it in the magazine.

development could not have been justified (unless there were fully compatible high-level compilers across all systems, an unlikely possibility).

It is unfortunate that the operating system of choice was pauper MS-DOS running on a skinny machine introduced two years behind the times, but that now is irrelevant. We have pretty much ignored MS-DOS in this magazine, but only because information about it is so widely available that there is very little that we can add. In practice, MS-DOS and the far-reaching effects of its application software on society cannot be ignored.

The S-100 system owner and user who understood his machine found himself in a dilemma: To give up his sophisticated hardware in order to run sophisticated software or to hold his ground and jealously rationalize that he didn't really need the "fancy graphics" anyway? The problem is, and we all know it, that MS-DOS application software is whole oceans more than fancy graphics.

The answer to the dilemma was unfortunately late in coming (too late maybe?), but it is here at last. Whatever you read in the remainder of this article, here's the message that matters: *The PoppyII is here. It runs PC-DOS with EGA graphics on the S-100 bus. It works! It is not just another S-100 board, it is a breakthrough. It comes from a company that is committed to the support of the board, that is responsive and supportive of users, that is excited about its product and already has a whole list of planned super improvements. But they cannot continue further development on this and similar S-100 products unless the board sells. Buy their board! You'll love it. If you are a system integrator, package one or more PoppyII's in your systems; your customers will delight in having a bunch of PCs inside one box with full access to the central storage media and the main line printer.*

THE PoppyII

The PoppyII is an IBM-PC clone on an S-100 board. This by itself is not relevant, but the PoppyII is a slave S-100 card built to function as a processing unit within a multiprocessing

POPPYII FEATURES

- Supports MDA, HMG, CGA, and EGA graphics.
- Runs PC-DOS locally as a guest operating system.
- Nearly 100% IBM-PC compatible.
- Parallel processor with host CPU (master) and multiple PoppyIIs.
- Each user may have his/her own dedicated PoppyII.
- Each user station can be up to 200 ft away from central system.
- PoppyII workstations have access to all of system's resources.
- Works with any PC-compatible keyboard and monitor.
- 8-MHz 8088 CPU running with no wait states.
- 20-MHz Zilog Super8 for peripheral functions.
- Approximately 1 Megabyte of on-board memory.
- Jumper-selectable I/O-port interface to S-100 bus.
- Local speaker and COM1-type serial port.
- Menu-selectable ON/OFF keyclick.
- Menu-selectable slow or fast auto key repeating.
- Menu-selectable blink underline or blink block cursor.
- Menu-selectable video off after 10-minute keyboard inactivity.
- Menu-selectable 44-character or 8-character keyboard buffer.

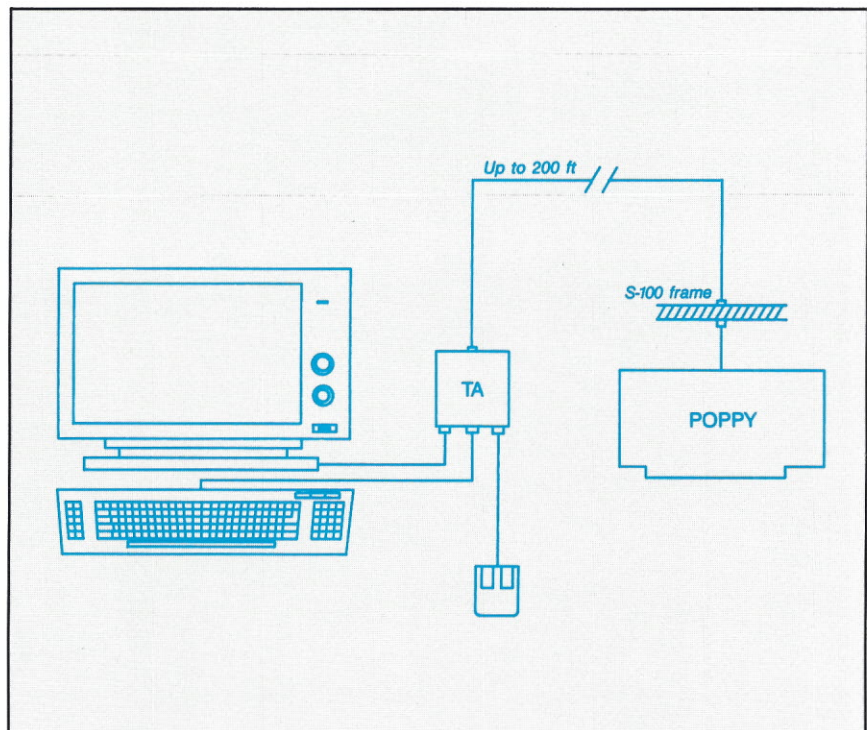


Figure 1. Diagram showing how the PoppyII connects to the Terminal Adapter and from there to the monitor, keyboard, and serial device.

environment. It can be added to an S-100 that is already running a multiuser operating system. Many PoppyII's can be added to a system for multiple parallel processing. Whenever it becomes necessary to add another workstation *with full EGA color graphics capabilities*, you simply get an extra keyboard and monitor and plug in another PoppyII. The breakthrough in the PoppyII is this capability to run EGA (IBM's Enhanced Graphics Adapter) software, never before available for S-100 systems.

The PoppyII does not run a PC-DOS emulation, it runs PC-DOS itself as a "guest" of the system's own multiuser operating system. But it also doubles as a workstation that runs the host operating system and has access to all its peripherals. Under TurboDOS for example, this means that from the

PoppyII keyboard you can run color graphics, other MS-DOS programs, CP/M-86 programs, and CP/M-80 programs. In this environment, the PoppyII is functionally equivalent to having a fast IBM-PC with a high-resolution EGA graphics card, a network interface card, and a Z80 coprocessor card.

IS IT REALLY 100% COMPATIBLE?

Not exactly, but you'll probably never notice the difference. The PoppyII, like many other clones, has difficulty with some "cheater" programs that bypass the operating system and take over the hardware. But even for most of these, the PoppyII can intercept the calls and reroute them properly; however, direct calls to disk controllers

are of relevant concern, since the PoppyII has no direct control over disk drives (more on this below).

Charter Information's position on compatibility is that you can assume that all your MS-DOS programs will run properly. If you find one that doesn't, they want to know about it and they'll attempt to make whatever adjustments are necessary to make it run. During my evaluation, ***every program I ran worked***. That included word processors (WordPerfect and WordStar), Microsoft Paint, CADD programs, SideKick, Turbo Pascal, and others.

DETAILS AND FEATURES

The Poppy connects to a DB-25 port in the back of the frame through a ribbon cable. A heavily-shielded twisted pair cable then carries the signals to a small box called the *Terminal Adapter (TA)*. The cable is fairly thick which doesn't bother me but may bother some users. The TA can be as

All the illustrations for this article were done using the PoppyII. The artwork on these two pages was painted on the screen with the mouse and the Microsoft Paintbrush program. The images were then photographed directly from the screen. The graphics on pages 37 and 40 were made with Laser CAD (DSL Inc.), then plotted on a Houston Instrument plotter.



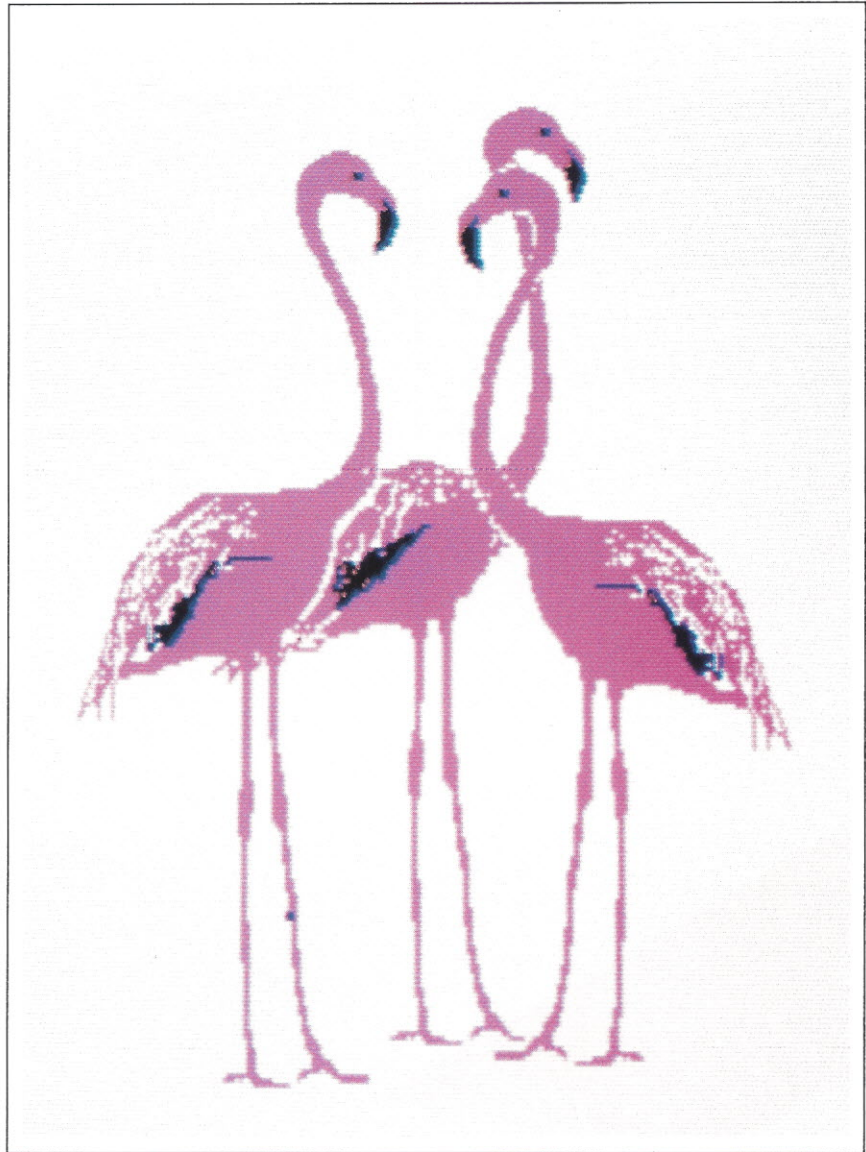
far as 200 feet away from the main frame, so the workstations of your multiple-PoppyII system could cover a significant area. The TA sits on the user desk, or mounts under it if you wish to have it out of sight, and has three output ports: for the monitor, the keyboard, and an auxiliary serial port that is equivalent to COM1 on PCs. This last port is primarily intended for a mouse, but it could also be used for any other serial local device, such as a modem or printer. Alternatively, the serial port could be mounted on the back of the main frame, which might be convenient for a single user buying the board simply to obtain IBM compatibility. In this case, you could probably also mount the TA logic inside the main frame to streamline your system.

The PoppyII does not support a parallel port. Remember however that the PoppyII user normally has full access (except as determined by the supervisor) to the host resources and ports, so in a typical multiuser installation, parallel ports would indeed be accessible. This will nevertheless limit the performance of PC-DOS software that expects to find a local parallel port. Future implementation of a local parallel port as an optional add-on is planned by Charter Information.

Besides EGA, the PoppyII display controller also supports MDA (IBM's Monochrome Display Adapter), HGC (Hercules Monochrome Graphics Controller), and CGA (IBM's Color Graphics Adapter). It automatically senses the correct display, but a different cable must be used for monochrome.

On the list of features of page 37, notice that the board supports a few keyboard attributes not typical of PCs. These can be set by the user simply by evoking a screen menu.

The main processor on-board the PoppyII is an 80188 running at 8 MHz. It also features a 20-MHz Zilog Super8 to take care of peripheral functions. The board includes 640K of user memory plus 256K of display memory. Other smaller blocks of memory (mostly ROM) are also present on-board for miscellaneous roles. The PoppyII interfaces to the S-100 bus through 8-bit selectable I/O ports. (In case you are wondering why it is called PoppyII, an earlier version existed which was not I/O mapped.)



PERFORMANCE

By PC standards the PoppyII is fast, nearly 3 times as fast when executing programs in memory. By newer clone standards (12 MHz, etc.) it is slower.

Microsoft Paint runs with instantaneous response to the mouse and displays vibrant colors. The speed of some CADD programs, however, tends to be slower because of the absence of a math coprocessor (another add-on planned by CI).

For an informal benchmark, we wrote a small Turbo Pascal graphics program that generates a sequence of about 35 spirals of different shapes on the screen. Then we ran it on the PoppyII, on a genuine IBM-XT, and on an IBM-AT. It took 4 min 12 sec on

the XT, 2 min 32 sec on the PoppyII, and 1 min on the AT. Thus, although slower than an AT, the PoppyII easily outperformed the XT. It should also be noted that both the XT and AT were equipped with math coprocessors while the PoppyII was, of course, running bare.

Unfortunately, there is a performance degradation in all disk accesses because these need to be requested through the host operating system, causing delays. But there is a nice feature: floppy drives can be reserved for use of PC-DOS only. PC-DOS, or rather a CI utility called PC-DISK, reads and writes to these disks in PC-DOS format. It can even format PC-DOS disks. Of course any host hard disks are also accessible to PC-DOS.

Switching between PC-DOS and

the host operating system is a one-command task. From TurboDOS for example, simply type BOOTPC to get to PC-DOS. Then CTRL-ALT-DEL returns control to TurboDOS.

The PoppyII comes with a small but very complete manual. It is written in a tutorial style which makes it very easy to understand.

I kept my PoppyII evaluation unit for over two months. Everyone in the office will have a long face when it leaves. I guess I'll be buying a permanent copy.

The PoppyII is a product of:

Charter Information Corp
2421 Rutland
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PoppyII prices:

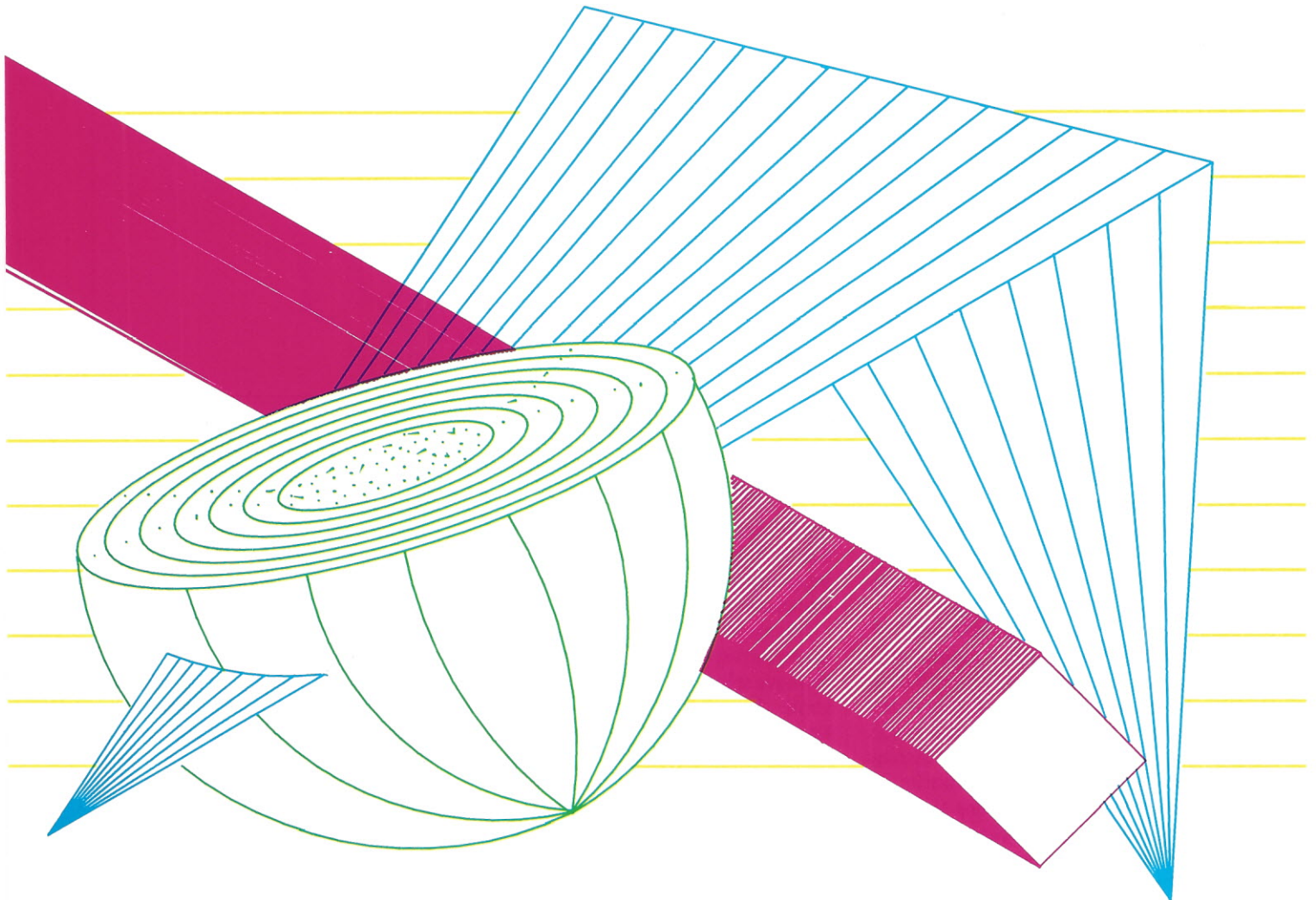
PoppyII, Terminal Adapter, and PC-Disk:

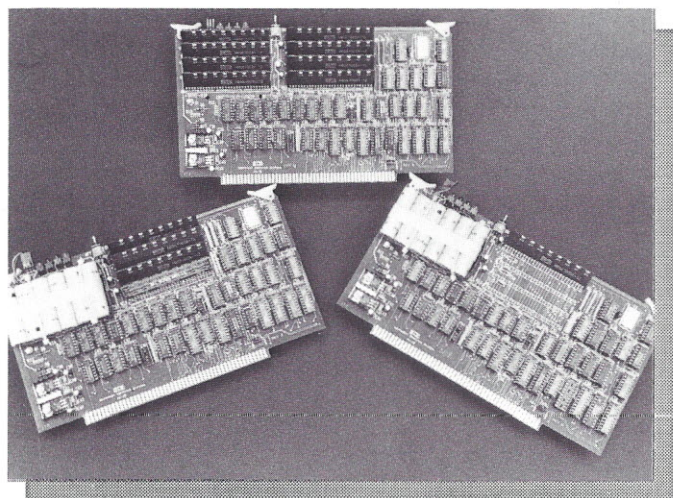
Qty 1 - \$1095; Qty 2-4 - \$950; Qty 5-9 - \$825; Qty 10+ - \$750.

PC-DOS, TurboDOS PC, TurboDOS drivers (source):

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Cables extra (from 60 cents to \$1.10 per foot). TurboDOS PC is required to run PoppyII with TurboDOS.





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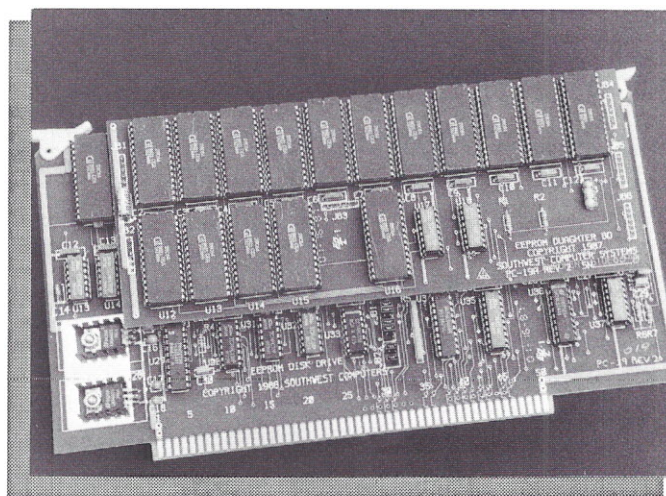
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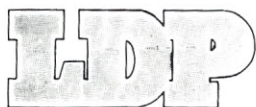
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(continued from page 19)

board, which sits in your existing old CompuPro hardware and really runs the store. The 386 software drivers shove the program loads over to the fast 1 Megabyte of Macrotech memory under the 386, leaving the rest of the system available as before with the regular CPU board handling I/O, etc. Of course you need CDOS to run it, but this is a 386, right? It won't read or write to disk any faster, but program operation and particularly such things as calculations should run at lightning speed. They can also be queued, so you can have several in the system each with its own terminal, or you can add extra virtuals to the master. It runs \$2665, so it's not cheap, but it's far cheaper than a current 386 machine of any stripe, and as an alternative to over \$4,000 that must be spent to upgrade older CPU, memory, and other such boards in a CompuPro to bring it up to the new standards, it actually becomes cost effective. If you've been contemplating upgrading to the 12.5-MHz CPU 286 (which also means upgrading the system support board and all your memory boards at least), you might give this one a look as a less costly and traumatic alternative.

Finally, by the time this appears, Digital Research will allegedly have published a new book cataloging the better than 600 CDOS-based programs that are now commercially available. That's CDOS, not MS-DOS, meaning they were designed for the Concurrent world from the start (such as Voyager, above). These include just about every type of program available, and the list is an eye-opener. Others are waiting in the wings to hear from us. I'm not personally any fan of WordStar, but MicroPro has been quite clear that they didn't release a Concurrent version of 4.0 because an insufficient number of people wrote them to ask for it. They've already sold the Concurrent rights to NewWord to another company that's now releasing a multiuser version. I'm certain that many other software companies would either release a CDOS version of their software or license a third-party company to do so if

enough people asked them that they felt it would be a profitable investment. The major reason for a big push for program compatibility with the MS-DOS world is the large variety of programs in every category available there. Far better, and superior, to have CDOS-based programs from the start.

What I'm saying here, as I said in the first column, is that the future of the S-100 computer is everybody's business, including the end user whether he or she be some half-baked novelist or a small or medium business running on S-100 machines. Software drives the industry, not hardware, and in business the best system often loses out to an inferior one on sheer marketing. All the video experts will tell you that the Beta format delivers a superior picture, far superior and more stable sound, and is far gentler on its tapes than VHS, but VHS has 90% of the market and only one manufacturer, the inventor of the system, still even makes Beta today while many commercial tapes are being released only in VHS format. Marketing is really the be-all and end-all of the industry, including computers.

Remember that not long ago Apple was going down the tubes under computer industry professionals and now has become a major force again under a former soft drink salesman. We don't have the marketing savvy from the manufacturers of S-100 computers to leave the job to them; they are computer professionals who can never grasp that excellent hardware won't always win out.

It's the S-100 users who must be heard. You must write the software companies and tell them you're there. You must be vocal to the third party suppliers of hardware, boards, and add-ons, telling them that, yes, there are enough of us out here who want EGA or AutoCAD or whatever, and that we'll buy those products if they'll produce them.

We shouldn't need to be 'compatible' — right now my CompuPro 816-C with its "antique S-100 bus" (the words of a current MS-DOS programmer to me recently) can do more than the much-touted but still vaporous OS/2 claims it will eventually be able to do. Right now, CompuPro's just waiting for decent 386 software and development tools to go

with its FlexOS version. Multitasking? I've got four virtuals on the PC Video and another on the Esprit, and I still have ten unused serial ports. Multiuser? I can connect up to sixteen with one add-on board, or give each their own 186 or 286 or 386, on my own personal system, and that's just for starters. And my current operating system is 20% the size of OS/2, which initially multitasks two whole programs and for multiusers still requires full networking.

Some antique, huh?

But we'll rise or fall not on our superior hardware and superior operating systems but on whether or not the vendors of S-100 third-party hardware and software know we're out there and know what we want and know we'll buy it if they produce it. Nobody will do it for you — but all of us together can breathe new life into this whole S-100 world of ours. The choice is yours.

Tip of the Issue for CDOS S-100 users: If it seems like your system's taking forever to come up or reset or you can make a sandwich while it loads a complex new program, you've got the dreaded Fragmented Hard Disk problem. That's when your files have been sliced like bologna and stuck all over the hard disk universe, so your system has to assemble them and your heads have to travel a mile or two to get all the pieces together in the right order. The MS-DOS world has a number of 'optimizing' programs to unfragment, none of which work with our machines, but there's a relatively easy way to do it if you regularly back up your entire hard disk anyway, as you most certainly should, either onto floppies or tape.

One time, when sluggishness is so obvious it's ridiculous, and after a 100% hard disk backup, do something radical: erase the entire hard disk. Yes, all of it, every user area and/or subdirectory. Or reformat it. Then stick the system back on and then simply PIP or COPY all your files back onto the now-virgin hard disk. CDOS automatically unfragments files when it does this. My reset time used to be 28 seconds; after this the system loaded and rebooted itself in 4.5 seconds. Other files, database sorts and access, etc. also quickened

by a factor of several hundred percent. Yes, it adds some time to backup/restore operations, and should be done not every backup but only when you notice the system really slowing down or the hard disk laboring from overwork, but the time spent in doing so will be repaid almost instantly.

And, oh yes — for those users who upgraded from 3.x or 4.x to 5.0 on a CompuPro, be aware that the Disk3 utility for 5.0 and up won't work any more. It requires files and information not provided until more recent machines and hard disks. Don't despair, though; your old DISK3.CMD from 4.1 — which you *did* save on a backup, didn't you? — will work just fine.

And, finally, if you're using DOS Media at all under Concurrent, under PC Video or on a terminal, did you know that PROMPT \$p\$g will give you a prompt with the name of your subdirectories, so it'll say C:/WS/LETTERS> instead of leaving you guessing? No? Try it.

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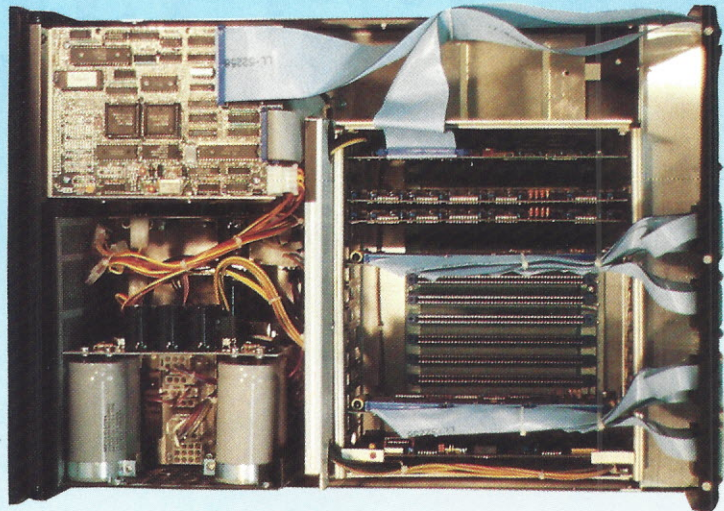
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THE WY-99GT

A WYSE TERMINAL

Thomas N. Ronayne

The other day, I took a good hard look at Wyse Technology's model WY-99GT terminal (I had one for a week for evaluation). The WY-99GT has all kinds of neat features: it emulates Wyse WY-50/50+, ANSI X3.64, DEC VT-220/100/52, TeleVideo 950/925/920/912/910+, ADDS Viewpoint A2, Hazeltine 1500, Lear Siegler ADM-31/4/3A, and PC terminals; it has a built-in calculator with five independent memories; clock with dual alarms and reminder messages; three-months at-a-glance perpetual calendar; an ASCII table.

The WY-99GT display format is 26 lines by 80 or 132 columns, and you get your choice of ASCII keyboard, DEC VT-220 keyboard, or 'enhanced' PC layouts, and it's got a P-134 phosphor 14-inch amber screen. You can program the function and the editing keys, locally print the screen, and make it do almost anything but scratch where you itch; golly bob howdy!

Out-of-the-box, you get the display head, whichever keyboard you choose, the keyboard cable, and the manual. You have to supply your own system cable, and the WY-99GT needs a DB-25 female connector on

its default 'modem' port and/or a male DB-25 on its 'aux-printer' port.

Like all Wyse terminals, it's got one shortcoming: the signal ground pin is tied to chassis ground (which can really cause crazy problems when you get ground loops).

My main interest in looking at the WY-99GT, though, wasn't (and isn't) any of the above. My interest was its Tektronix 4010/4014 graphics features (although I was also interested in its VT-100 emulation — I've grown accustomed to VT-100, and I like it). It also does "PC-compatible Hercules or IBM Color Graphics Adapter (CGA)," which I couldn't care less about and didn't look at, but which could be useful for those of you using PC terminals. Wyse advertises the WY-99GT as "Affordable, High-Quality Graphics and Text" terminal. Question: "How'd they do?" Answer: "Pretty darn good!"

If you're in the engineering business — or in the engineering computer support business — you're interested in Tektronix terminals. Most computer aided design (CAD) and computer aided manufacturing (CAM) and computer aided engineering (CAE) systems that mean anything in the real world can display their output on

Tektronix terminals, and Tektronix' 4010/4014 terminals are pretty much the de facto standards.

So, given that 'real' Tektronix terminals cost upwards of \$4,000 (well upwards), it'd be great if you could, maybe, buy a terminal that will do what Tektronix' do for about \$650. That, in a nutshell, is what the WY-99GT is supposed to be.

Is it a Tektronix 4010/4014? No. Is it an acceptable clone? Yes, maybe.

The WY-99GT will draw a picture, you can see the picture, and the picture is acceptable. It is not as sharp an image as a Tektronix does (so, what'd you expect — they get the big bucks because they deliver the goods), and it doesn't really 'draw' like a Tektronix does (Tektronix terminals are "pen plotters on a screen"). Be all that as it may, it's darn good.

PLOT 10 TERMINAL CONTROL SYSTEM

Plot 10 is a graphics library, supplied by Tektronix (for \$3 grand), for plotting on a Tektronix terminal. If you have a Tektronix terminal (or a clone), you have a choice: you either "roll your own" or buy Plot 10 from

Tektronix. If you're using a CAD/CAM/CAE system that supports Tektronix graphics, you may already have Plot 10 (or a clone) available.

As it turns out, I've got access to 'real' Plot 10. Plot 10 includes a 'verify' program that puts a Tektronix terminal (and any 'pretenders') through every gyration a Tektronix terminal can do. If you say you've got a 4010/4014 emulator, you ought to be able to run the verify program on it and get a specific set of expected results.

So, how'd the WY-99GT do? Quite well — it runs dead 'right,' and only messes up a couple of things. It doesn't, for example, do area fills like you'd expect, and some screen controls don't work the way they should (Wyse is working on this). However, for most graphics needs, the WY-99GT works just fine, thank you very much.

WORK-A-DAY MODE

Fortunately (or unfortunately, depending on how you look at it), you don't do all your work in graphics — lots of stuff gets done with editors, compilers, and other plain-jane programs that require a plain, semismart, straightforward tube.

That means that you've got to be able to switch from, say, 4010/4014 emulation to, say, VT-100 emulation, and use the thing with an editor.

In the VT-100 mode, used with editors, word processing, spreadsheet, menu-oriented applications, and other run-of-the-mill applications programs, the WY-99GT hung right in there and worked just fine.

I tried other emulations — the ADDS, ANSI, Lear Siegler, and TeleVideo — that I had termcap en-

tries for, and the WY-99GT performed as expected; it worked.

Also, it produces acceptable output — in the 4010/4014 mode — from UNIX' troff typesetting program.

That, by the by, is not damning with faint praise. Electronic things either work or they don't. There ain't no maybe. The WY-99GT works.

How's it to use? OK.

It comes in a two-tone plastic cabinet with a swivel and tilt base. It weighs about twenty pounds, and you can't knock it over easily. The keyboard is the typical low-ball PC-

strange reaches for any key you'd normally use in text or programming.

I'm used to a P-39 phosphor green screen that produces characters that look like a daisy wheel typewriter — sharp as a tack. The WY-99GT has visible dots in the character matrix — but, screen contrast is good enough that my eyes didn't hurt after many hours. Not great, but not bad either.

In the 132-column mode, the screen looks just about like you'd expect in a 14-inch tube: scrunched. It's readable, it's usable, but I found it hard to look at for long.

The WY-99GT comes with a user manual that doesn't tell you how to use any of the fancy-schmancy stuff (all those 'features' listed above). For those, you have to spend \$40 to buy the 'programmer's manual.' I didn't.

SO, IS IT A WYSE (sorry) BUY?

If you need an inexpensive alternative to a Tektronix 4010/4014 terminal for graphics, the WY-99GT is a great buy at about \$650 (plus the 40 bucks for the silly book on how to use the thing's extra goodies).

It produces acceptable graphics, it's easy to use, and



style everybody seems determined to copy (why everybody in this business seems determined to go with the lowest common denominator is well beyond me). If you like PC-style keyboards, you'll like this one. I don't like PC-style anything, and, if you don't, you won't like it either, but I have to note that I could use it for eight or so hours at a stretch and not hurt when I got finished. They did a 'good' thing with the keyboard: they put Cherry key-switches in it — which have, to my hands, great feel — and the keyboard layout is OK; keys are where you'd expect them to be, and you don't have to do any

it's 99.44% Tektronix 4010/4014 compatible. As an ASCII terminal, it can hold its own with most of 'em out there, but I wouldn't buy it just for its ASCII capabilities; you buy one of these guys for the graphics.

You'd probably want to buy the extra-cost book (\$40) and the extra-cost arm (\$100) for raising the terminal head off the table, and you'd sure want to isolate the chassis ground from your system, but other than those, you shouldn't have any problems, which is to say that you'll probably like the thing and get many miles out of it.

Thomas N. Ronayne is president and chief programmer of Advanced Programming Techniques Corporation, a Cromemco dealer in Detroit specializing in scientific and technical custom programming.



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► ED INTERFACE

(continued from page 4)

see an unexciting trend among many (not all of course) hobbyists: A number of you have held on to *OLD OLD S-100s* without upgrading them for many years. The idea behind the S-100 bus is that you *upgrade it regularly* and therefore keep up with the latest technology without having to throw away the whole gizmo like the IBM consumerist world does. But if you never upgrade, you should have bought a Kaypro in the first place. You should, at the very least, buy a new S-100 board every two years in order to keep up. That means that if you have a 1977 system and you have never upgraded, you are behind at least five boards, so basically you need to replace all or nearly all your boards, and in some cases even the motherboard, in order to bring your system up to date. Also, if you call yourself a hardware hacker, or even hobbyist, you should be the guy who, instead of playing around with 10-year old systems, can't wait for the latest stuff, and is the first to get the latest chip, and already has it working before any commercial products based on it are even announced. (Of course there are those of us who like to have an original unmodified Altair or IMSAI for nostalgic and collector's reasons, but that's a different matter.)

We plan to support through the magazine the development of products that can be very useful to single-user systems, but how much you respond to these projects will determine the Journal's support of such products and their manufacture by companies. One such product in development now is a Z280 S-100 board that should breath much-needed new life into the many Z80 systems in use. Kevin Parker of KepTronix has been working on such a board and Jimmy Song of S.C. Digital is also developing one. These boards will allow your old Z80 systems to address 16 Megabytes while still letting you run all your existing software but much faster. Response to those products will allow us to judge how active (hardwarewise) the large S-100 Z80-compatible community really is or whether it is simply stagnating.

Back to the survey results. I have

been telling everyone that a little over twenty OSes run on the S-100. Apparently it is quite a bit more. Here are the operating systems in use by the *S-100 Journal* readers that answered the survey:

CP/M	38%
MS/PC-DOS	15%
Concurrent DOS	8%
Z-System	7%
CP/M-86	6%
TurboDOS	5%
Cromix	3%
CP/M-68K	3%
UNIX	3%
Cromemco CDOS	2%
MP/M	2%
AMOS	2%
NorthStar DOS	1%

With less than 1% response were: FlexOS, ZR-DOS, SK-DOS, RT-11, OS-9, Pro DOS, H DOS, MRS, Conix, Mits, Micronix, Mumps, M DOS, XENIX, Micropolis DOS, Z DOS, and proprietary. To be honest, I had never heard of some of these, so I couldn't tell you if a couple couldn't be misspellings. Still, very interesting.

Equally interesting are the CPUs in use:

Z80	39%
8088	9%
68000	9%
8085	9%
80286	9%
8086	8%
8080	8%
64180	2%
80287	1%

And with less than 1% response: 68010, V20, Z8000, 80186, 80386, 8087, 68020, 6502. The question did not distinguish between main processors and coprocessors. The huge margin obtained by the Z80 is no doubt because of the immense popularity of the chip on S-100 slave boards. Nearly every multiuser system supports Z80 slave boards; add that to the many Z80-based single-user systems and the results show.

And finally the breakdown by companies. Please note that our question asked for brands of systems or main

CPU boards only, so these results are not an indication of the total installed base of each company, only of their installed CPUs and systems among our readers. Also systems take priority over boards, so a CompuPro system with a Macrotech CPU would likely be listed under CompuPro rather than Macrotech.

CompuPro	22%
Zenith	9%
NorthStar	9%
Cromemco	8%
Homebrew	6%
IMSAI	5%
Teletex	4%
ICM	3%
Alpha Micro	3%
Jade	2%
Ithaca	2%
Altair	2%
Macrotech	2%
ADC	2%
Lomas	2%
IMS	2%
SSM	1%
Earth	1%
SDS	1%
Sierra	1%
Computime	1%
Morrow	1%

And listed with less than 1%: Tarbell, Inner Access, Vector Graphic, SC Digital, Exidy, Polymorphic, SD Sales, Sol, Micro D, Mits, Mangum, Ackerman, US Micro, Seattle, Tecmar, Intronics, PMMI, Dynatech, CDC, Intellicomp, SCP, and Delta. For the reasons mentioned, companies that make only memory boards or specialty peripheral boards are not included.

Finally, we asked readers to rate with a point system the types of subjects that they would like to see in the magazine. Here are the winners from among a multitude of topics:

Reviews of S-100 Hardware	3691 pts
Technical S-100 Bus Articles	1850 pts
New Products and News	1826 pts
Operating Systems Articles	1785 pts
S-100 Applications	1771 pts
Software Tips and Techniques	1720 pts
System Integration	1610 pts
Building S-100 Boards	1600 pts

I hope that S-100 companies and potential S-100 companies are reading this. We've always said that in general most S-100 users want to buy new products if only significant products are offered for sale. Note that both the grand winner (by a whopping margin) and the third place winner imply that the S-100 user is looking for new products. As I said in the last issue's editorial, "How about developing them?"

The survey indicates that *S-100 Journal* has pretty much covered the subjects that are in most demand. We have been weak in S-100 Applications, the 5th most demanded type of article, and we will try to cover this area better in the future.

These survey results should help everyone get a clearer picture of the nature of the S-100 community. This was our first survey, so it is not a perfect survey (are they ever?), but we think the results are significant. We will have more surveys in the future and will make them better based on what we learn as we do it.

In order to make room for all this, I am not publishing any letters this time, but I think you will enjoy reading a few of the comments that accompanied the survey returns:

"Additional articles on VMEbus and Multibus are welcome as a method of expanding *S-100 Journal* as long as there is no impact on the S-100 emphasis."

"Keep up the good work."

"This is the best magazine questionnaire that I have received."

"There are plenty of other books that cover all the other buses in use. Why

ruin a perfectly good magazine? S-100 users are using 'the right bus' for a good reason."

"I feel that you must cover MS/PC-DOS systems, and go lighter on CP/M."

"I would like to see articles on running MS-DOS (IBM) programs on CP/M systems."

"Much too glossy — it's hard to read when the pages give off such an awful glare. Also the paper is too heavy."

"PLEASE STD BUS TOO!!! Expand this publication carefully! But please do it. I want to keep you around for a while."

"More articles on ZCPR3. Thanks."

"What I need to know is what O/S, hardware, etc., are available and what it will do for the user. A lot of your magazine blows right past the casual user whose knowledge of systems is limited."

"Good Magazine."

"I would like to see some articles on the Z-System and a direct hook-up LAN."

"I am interested in the VMEbus."

"I would like to see more on the Concurrent DOS operating system."

"Enjoy reading the magazine — keep up the level of quality."

"I may not renew anyway, I am more technically inclined than the magazine."

"Your magazine serves a very definite need. I think it's at about the right mix of levels & topics. I hope it continues to grow."

"I enjoy the construction/development projects."

"Please please don't forget the homebrew S-100 user. I *need* this S-100 mag to keep me informed on S-100 stuff. Please keep your current look."

"You have a great magazine. Nothing else like it exists."

"Can you get it to us any faster — like on time?"

"I think you are doing a great job for S-100 computers. I would not like to see the VME/Multibus articles overshadow S-100."

"It's nice to get a survey. I wondered who the other magazines chose for their surveys."

"The direction you seek to expand is a useful one. But stay away from the PC clones please! If I want to read about clones, I can get a magazine dedicated to that. Remember, you are unique. Please try to stay that way!"

"I subscribed in the hope that I might be able to glean some useful information about extending the capabilities of the excellent Z-100. There are a lot of Z-100's, so I can't be alone."

"Would like to see an expansion of the 'readers questions' or 'editor interface' and a BBS started."

(more on next page ►)

NOTICE OF SUBSCRIPTION RATE CHANGE

Effective January 25, 1988, the subscription rate of *S-100 Journal/Supermicro* will change as indicated below — the cover price will be \$8.00. All extensions, renewals, and new subscriptions up to 16 issues will be honored at the old rates if received before January 31, 1988.

	1 Year/4 Issues	2 Years/8 Issues	4 Years/16 Issues
OLD RATES	\$14.00	\$25.00	\$45.00
NEW RATES	\$24.00	\$40.00	\$80.00

"Please become more regular in your delivery."

"I really enjoy your magazine. Keep it up."

"Undecided but won't cancel."

"I liked the article by Jack L. Chalker. Keep more of this type of thing coming. Need more articles on software."

"I will continue to subscribe."

"NO IBM! I tire of PC-DOS/UNIX/IBM stealing magazines from me. As long as the name and coverage of the S-100 does not change, then I welcome the VME and Multibus, but we need a magazine that specifically deals with the IEEE 696 bus."

"I look forward to receiving each issue and wish you the best luck."

"I am seeking an organized Altair Users group to join so that I may keep abreast of spare parts and software information for this product as well as ways to convert it to a more modern machine."

"I am an Eng. student and will have a need in the very near future for a system that supports good graphics for electrical computer eng CAD."

"I am very interested in the PICK operating system — Have not seen any S-100 company heading that way but VME & Multibus yes."

"We need 32 bits NOW. Perhaps you can focus user and vendor attention."

"I will not continue to subscribe *unless* you begin to cover the VMEbus."

"The company I work for is involved in Hi-Res color graphics design software. We used S-100 computers until about 1984. If the hardware and the consumer demand is there, we might reenter the S-100 market. Speed and dependability (high MTBF) should be emphasized. 32 bit systems are needed for speed."

"I am pleased to see Jack Chalker & hear his views. I have made Noneman's LS100 changes and they

worked 1st time exactly as described. Keep up the good work."

"Fine! Full Speed Ahead."

"I do not want to see decreased coverage of S-100 if other buses are included."

"My system is down half the time due to chip failures, yet no one has written anything useful on getting back up."

"I would like authors to cite experience with their projects/products as used in Cromemco Systems."

"Keep up good work — Consider journal important for product release/specification information — e.g., ads, reviews."

"Just remember that most or many of your readers are not familiar with the VME & Multibus, so keep it simple (kiss) at least in the beginning."

"Good stuff. Would like to see more on TurboDOS; e.g., Systems Networked to PCs."

"Make software available on disk or BBS."

"So long as a high % of content remains S-100; this is, of course, why we all subscribed in the first place."

"Articles discussing in detail and comparing the relative advantages and disadvantages of the S-100, VMEbus and Multibus would be of interest."

"I feel short listings are great, but longer listings could be made available on a BBS or Disks. An occasional peek into the current STD bus world might be interesting."

"I have been using S-100 bus computers for 7 years and have no desire to use a PC. So please continue coverage of S-100 products."

"Hold the line on subscription costs."

"Help spur on Multiuser MS-DOS Types on S-100 — Software companies are forcing users to switch hardware due to shifts in programming."

"All our new hardware is geared toward VMEbus."

"Good move!"

"Of course I would continue to subscribe, you are about the only source of info on current S-100 manufacturers."

"I would like to see more articles about upgrading older equipment."

"I would like to see much more user feedback on how they have applied what hardware/software to their application and how they integrated it. What if any tricks they use. Print *many* short items."

"All I ever read is how S-100 users are smarter than everyone else. I subscribed to learn about S-100 (how to put together a system). So far I have wasted my time. Why not try to bring PC users to S-100 and help them instead of patting current users on the head."

"Keep up the good work. I am a hacker working toward an all-CMOS system, with mass storage with no rotating parts (SRAM & Bubble). I am interested in anything along this line."

"Include Standard Bus as well as VME & Multibus."

"Would very much be interested in building VME systems/networking and/or building S-100 boards."

"I enjoy the look and feel of the publication. Very technical articles are over my head, but I would like to learn. Perhaps something on basics would help."

"If you cover VME or Mbus keep it hardware oriented. We already have too many software rags."

"Those of us who began with S-100 bus have no other place to go. Keep up the effort to continue S-100!"

"Other buses as long as you cover S-100 — 80% of the time. In some cases your writing is too technical."

"Always willing to look at new info."

WORDSTAR REL.4 FOR CP/M, Z-SYSTEM, AND TurboDOS

Jay Vilhena

MicroPro's WordStar, originally created for the CP/M environment, was the first word processor to achieve major acceptance among microcomputer users. As software developers shifted their attention to the MS-DOS environment, MicroPro did likewise, so newer versions of WordStar targeted MS-DOS only.

However, the CP/M community remains active, and, at the initiative of User's Groups, BBSes, and CP/M columnists, MicroPro was flooded with letters from users requesting the release of an updated CP/M version of WordStar. MicroPro, currently calling itself *The New MicroPro*, is traversing a very commendable period of high responsiveness and strong support of users, thus, in response to the letters, WORDSTAR CP/M EDITION, Release 4 is now available.

Bear in mind that it is no easy task to produce an efficient major word processor within the memory size restrictions of CP/M (which can only address 64K). MicroPro solved the problem by accessing the disk frequently to swap pieces of a long text file, to retrieve the screen menus, etc. This is only a bother if your current level of expertise with WordStar re-

quires the display of the menus, since the disk is accessed every time you use a command from a submenu. At any rate, if you are exercising the options offered by the S-100 bus, you really should have RAM-disk boards installed, so the above problem becomes irrelevant.

And since we are on the subject of CP/M and memory sizes, you should know that CP/M 2.2 as an operating system is now outdated and unsupported. If you favor a CP/M-like environment and would like to continue using your CP/M programs, you should consider the Z-System (originally known as ZCPR) which is contemporary, fully supported, and continually being updated by Echelon, Inc. The CP/M community is very much alive, but anyone who wants to stay current in this environment can only do so through the Z-System. The Z-System is very affordable and 100% upwards compatible with CP/M 2.2. MicroPro has of course recognized the above facts, so the new WordStar offers Z-System support (see text box on page 55).

It is now possible to break the 64K memory limit as well. The new Z280 CPU chip from Zilog is fully compatible with the Z80 but can address 16

Megabytes, among other significant improvements. I know of no Z280 S-100 board currently available, but I know of at least one under development (see box at the end of article).

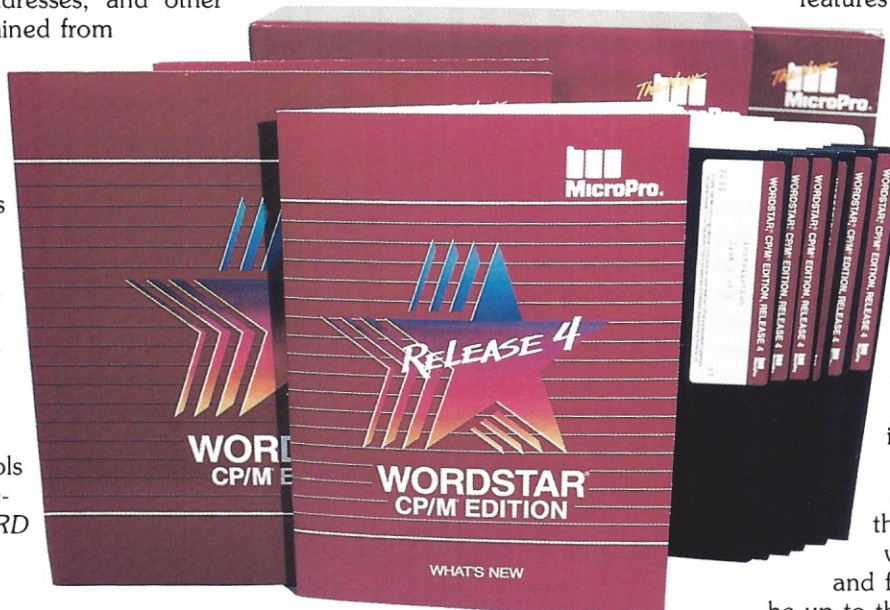
The above comments seemed appropriate. Back to WordStar: WordStar 4 also features multiuser support (for TurboDOS, MP/M, etc.), offering file-locking capabilities. There are many other improvements over previous editions. MicroPro claims over 120 enhancements. Most of these are actually transfers from NewWord, so the new WordStar offers the best of both worlds. In this review, I will describe WordStar in general, but I will concentrate on the new features.

WORDSTAR GENERAL FEATURES

WordStar is a complete word processing package featuring text formatting with various justification options, printer control, full-screen editing, file manipulation, block operations (move, copy, etc.), on-screen menus, on-line help, and all the other standard conveniences typically found in good word processor programs.

In the original configuration, most WordStar commands are either issued directly through CONTROL-key sequences or embedded in the document through dot commands — a period followed by two or more alphanumeric characters. How controls are issued from the keyboard and how WordStar responds can be extensively customized (see *Installation* further below).

Besides editing of documents, WordStar offers an array of additional services and utility programs. You can for example chain print several files or even nest files while printing (i.e., a file is printed within another). Or you can automatically produce multiple form letters addressed to different parties with names, addresses, and other information obtained from a mailing list. This facility is very complete. It features if-then-else conditional statements that allow printing variations of a letter to different addressees — based on differences of ZIP code, title, etc. Additional word manipulating tools are described below in *The WORD Plus* section.



THE NEW FEATURES

Following are a few details on the new features offered by WordStar 4:

Screen attributes: Assuming that your terminal supports it, you are no longer bound by ^Bboldfacing^B or ^Sunderlining^S, instead you can choose to have **boldfaced** or underlined words displayed properly without extraneous control characters. WordStar will also highlight **italics**, **alternate color**, **doublestrike**, **subscripts**, and **superscripts** usually by displaying the corresponding words brighter. **Marked blocks of text will appear in reverse video.**

Keyboard macros: This is in my opinion the second best of the new features (my favorite is the customization program WSCHANGE describ-

ed later). You can define up to 36 macros — using the 26 letters and 10 digits. Then simply type the ESC key plus a letter or digit to execute a sequence of commands or words that you defined as a macro. You can make definitions permanent (saved to disk) or define them as needed while editing. You could for example define the sequence ^PBZ-System^PB under Z and, thenceforth, simply type ESC Z everytime you wanted to type Z-System in bold. Up to 512 bytes are available to define macros; this is a default value that you can modify with WSCHANGE if you need more bytes. And you can easily display all the macro definitions if at anytime you need to look up what has been defined.

Index and Table of Contents: Another powerful feature! WordStar will index the words in a file in alphabetical order showing the page number where each word occurs. Non-meaningful words are automatically excluded and additional exclusion lists can be easily developed by the user. WordStar will also produce a Table of Contents from marked chapter titles throughout your file.

Unerase: Everytime you use a command that deletes text, WordStar saves the erased text in a memory buffer. Then, with the command ^U, you can restore the portion of text that was last deleted.

Column blocks: You can define a vertical block of any width and then perform regular block operations with

it. Handy to manipulate tables of data!

On-screen calculator: A built-in calculator allows four-function math while editing. The calculator accepts long expressions containing nested parentheses, negative numbers, floating-point numbers, and scientific notation. Either the expression or its calculated result can, with a simple command, be inserted at the cursor position. In addition, WordStar can add up all the numbers found within a marked block. This is particularly useful to add columns of numbers (after defining a column block). Numbers in parentheses are recognized as negative numbers.

The above are the most important new features. Other significant new features include: Support of user numbers.

Drivers for printers that support proportional spacing and incremental justification (i.e., justification is done by incrementing every space a little instead of doubling a few of them). Embedded ruler lines: this means that you have more flexibility in using multiple tab and margin settings in the same file and the settings are saved with the file. Header and footer lines can now be up to three lines long. Files can be protected to avoid accidental change. Four print control commands are now reserved for custom definition while editing... There are many other improvements; Table 1 describes all the new commands so you can have a clearer picture of the scope of the new features.

INSTALLATION AND CUSTOMIZATION

The basic installation of WordStar 4 is extremely simple. All you do is select your printer and terminal from a couple of menus, and you're done. Since the list of terminals and printers is very extensive, chances are that yours is listed. WordStar comes with drivers to support over 100 printers

for example. The drivers I used seemed fairly complete and supported the main terminal and printer features.

The customized installation involves the use of a program called WSCHANGE. This is the kind of program that we all wished operating systems came with to implement them on specific hardware and to modify their BIOS or XIOS. It is a multilevel menu system that allows broad customization of WordStar mostly by answering YES or NO questions. The multiple levels are somewhat confusing at first, but with a little patience you can get your bearings and savor the rewards of taming WordStar to your liking. You can modify nearly all of WordStar's default values, including size of memory buffers, how the display looks, printer controls, etc.

The more versatile application of WSCHANGE, however, is to automatically create WordStar patches that allow for very extensive customization. This, however, involves more than answering YES or NO questions; you need to enter sequences of hexadecimal code corresponding to whatever features you want to modify. You'll need at least a table of ASCII to hexadecimal and some time to study a file called PATCH.LST (print it out) which contains the user area source code. Knowledge of assembly language is not really necessary (unless you want to implement your own routines; they've made it easy to link them into the existing code), since with a little study and experimentation you can figure out what's going on. Obviously none of this is really indispensable to run WordStar anyway, but for users with unsettling exploratory tendencies (particularly while the boss admires your dedication to getting acquainted with the New WordStar features) and for OEMs packaging customized versions of WordStar with their systems, the tools are there and the customization limits are wide.

THE WORD PLUS

The WORD Plus is a group of utility programs that comes with WordStar. The most important of these are SPELL, MARKFIX, REVIEW, and LOOKUP. SPELL will look through a text file and display or save the

misspelled words that it finds. REVIEW allows viewing the sentence where each misspelled word appears and displays a few suggestions for alternative spelling. MARKFIX corrects the misspelled word in the original text. To make the process easier, another program, TW, manages SPELL, REVIEW, and MARKFIX as a consolidated process complete with menus. The whole spelling process offers various user options for versatility. You can, for example, tell it to ignore uppercase words, such as company names, so they don't show up as misspellings. LOOKUP is similar to REVIEW but it's to be used without a text file: simply enter a word that you are not sure how to spell and LOOKUP displays a list of correctly-spelled potential candidates for your word.

These utilities rely on a 45,000 word dictionary that comes with WordStar. At first you will find that the standard dictionary takes care of all the mundane spellings but does not recognize many of your correctly-spelled words, and tries to tell you that they are misspelled. Fortunately, the programs allow the addition of custom dictionaries, so gradually you can build these up to make spell checking more effective. One problem with the whole spell checking process is that it cannot be used *while* editing a document, it operates on disk files only. This is obviously because of the

WORDSTAR 4 SUPPORTS Z-SYSTEM FEATURES

Knowing the modern replacement for CP/M is Z-System, MicroPro programmers worked with Echelon's staff to produce a version of WordStar fully supporting the advanced features of Z-System.

In order to enable the Z-System features of WordStar, the user simply installs the program with the Z3INS utility supplied with ZCPR3 and Z-System and selects ZCPR in the WSCHANGE menus. The maximum user area number is 31 under Z-System — CP/M handles only up to 15.

After installing WS4 as a Z-System utility, named directories may optionally be used to log onto another drive/user and as part of a file name. Z-System paths are used to find command files and WordStar's own overlay files. Additionally, WordStar installs itself as a Z-System 'shell' permitting any legal Z-System command to be entered when running a program, including complex aliases and CCP, RCP, and FCP commands. None of this is possible using CP/M.

(This text box courtesy of Echelon, Inc.)

memory limitations of CP/M.

Other utilities included with *The WORD Plus* are HYPHEN, an automatic hyphenation program; WC, to count the number of words in a text file; and ANAGRAM, to unscramble words, e.g., *rta* into *rat* and *tar*. Another utility, FIND, locates sets of words from a wildcard. For example, when you enter *b??t*, it will find *boot*, *beet*, etc., when you enter **at* it will find all the words that end in *at*; also, *?* and *** can be combined in your wildcard. Finally, WORD-FREQ compiles a table of how many times each word appears in a document. This type of analysis is sometimes used to ascertain the authorship of a literary piece, but I am sure that you can find more practical uses for it.

DOCUMENTATION AND SUPPORT

WordStar CP/M Edition, Release 4 comes in an attractive package that includes a 430-page manual, quick reference card, and a booklet with an overview of the new features. The manual is bound with a spiral-type wire that allows folding it over for easy usage. Ten progressive, easy-to-understand lessons guide the new user into familiarity with WordStar. A comprehensive A-to-Z *Reference Guide* discusses all relevant

<i>Opening Menu</i>		<i>Merge Printing</i>	
C	Protect file from changes	.EI	End of .IF condition
I	Index a document	.EL	Reverse sense of previous .IF
T	Create table of contents	.GO	Skip to top or bottom of file
Esc	Define macros	.MA	Set a variable to result of a math equation
?	Display serial number and TPA size	/	Format variable data as requested
<i>Editing Menu</i>		&#&	Substitute current page number
		&_&	Substitute current line number
<i>Macro Definition</i>		<i>Dot Commands</i>	
CNTRL-O	Set tab width of a nondocument	.AW	Word wrap and paragraph align ON/OFF
CNTRL-U	Interrupt command or restore erased text	.F1	First line of footer (same as .FO)
CNTRL-^	Convert hard return to soft	.F2	Second line of footer
		.F3	Third line of footer
Esc ?	Display or change macro definitions	.H1	First line of header (same as .HE)
Esc n	Define text as a macro	.H2	Second line of header
Esc =	Insert result from last math calculation	.H3	Third line of header
Esc \$	Insert result but format to dollars	.IX	Following text is index entry
Esc #	Insert last math equation performed	.LM	Set left margin
<i>Block Menu</i>		.LQ	Turn letter quality print ON/OFF
CNTRL-KI	Turn column replace ON/OFF	.LS	Change line spacing
CNTRL-KM	Total all numbers within block	.PG	Restore default page numbers
CNTRL-K''	Convert characters in block to uppercase	.PM	Set first-line indent of paragraph
CNTRL-K'	Convert characters in block to lowercase	.PS	Turn proportional spacing ON/OFF
<i>Onscreen Menu</i>		.RM	Set right margin
CNTRL-OB	Turn soft space indicator ON/OFF	.RR	Set ruler line
CNTRL-OO	Embed current ruler line	.TC	Following text is table of contents entry
<i>Print Menu</i>		.UL	Turn continuous underline ON/OFF
CNTRL-PI	Insert 8-column tab	.XL	Redefine form-feed character
CNTRL-P@	Align text at fixed position	.XE	Redefine a custom print function (E)
<i>Quick Menu</i>		.XQ	Redefine a custom print function (Q)
?	Wild card option in find/replace	.XR	Redefine a custom print function (R)
R	Option to replace to end of document	.XW	Redefine a custom print function (W)
CNTRL-P	Option to find/replace a control code	<i>Status Line Display</i>	
CNTRL-QG	Move cursor forward to given character	Column	Column mode is ON
CNTRL-QH	Move cursor backward to given character	ColRepl	Column replace is ON
CNTRL-QI	Go to given page (document) or line (nondoc)	Spacing-n	Shows current line spacing
CNTRL-QM	Call calculator (add, subtract, multiply, divide)	Dot-Limit	Maximum number of dot commands
CNTRL-QT	Delete to a given character	Large-File	Doc too large to fit entirely in memory
CNTRL-QU	Realign whole doc or strip MSBs of nondoc	Prtect	Protected file
CNTRL-Q?	Count characters to cursor position	Align	Alignment is ON
		Auto-In	Auto-indent is ON for nondocument

Table 1. New commands of WordStar Release 4. This is not a list of all WordStar commands, it includes only those that are entirely new. Also not included are all the original commands that have been improved/modified.

topics in detail. Good Manual!

In addition, MicroPro offers 90 days of free technical support plus extended support at \$8 to \$10 per month. The extended support includes a toll-free number. All registered users also receive *WordStar News*, a bimonthly publication that covers issues relevant to all WordStar users. The last issue I received had a fair share dedicated to CP/M Edition users.

PERFORMANCE AND LEFTOVERS

I tested most of the features that I described in this article. I did not test the merge printing options nor the incremental (micro) justification. WordStar CP/M Edition, Release 4 is a new product, and my association with it has not been extensive, but so far most everything seems to work well.

This implementation is faster than previous editions. Even the disk accesses to actual drives are surprisingly fast (at least with my Qume 8-inchers). Unfortunately, not all features of smart terminals are implemented. For example, there are no line graphics, and WordStar still rewrites the screen when scrolling instead of using the vastly more efficient scrolling capabilities built into the terminal. Alas, most CP/M users have non-S-100 systems which lack intelligent serial terminals, so implementing these features is probably not worthwhile for MicroPro.

I find a couple of other personal annoyances with WordStar. I always use a steady block for a cursor, and WordStar keeps stealing it to go up and update the status line. This lasts a microsecond but in my terminal it shakes the cursor enough to bother me. There are a few customization options to change the frequency of status line updates, but my option was to do away with the status line, a task easily accomplished with WSCHANGE. It also bothers me that the cursor jumps over blank space on my screen; I've found no way to change this. I would prefer being able to move through blank space and go insert something anywhere I want. Finally, I find it impractical to use double-key commands for something as mundane as cursor movement. That's why arrow keys were invented.

My hands have gotten used to the location of the arrow keys on my terminal, and any editor or word processor that I use should adapt to this, not the other way around. WordStar does offer a customization option with WSCHANGE that produces a patch for WordStar to translate function key sequences into native commands. I tried to use it to get WordStar to respond to my arrow keys, but it just wouldn't work. I eventually gave up and reprogrammed the arrow keys locally (in the terminal). This is a little less practical since the keys need to be changed back after each WordStar session, so they'll work with my other software. However, WordStar provides for patchable subroutines to *Initiate* and *Uninitiate* the terminal, so I could probably use this route.

It all boils down to the fact that the user interface to a word processor is a very personal matter where preferences vary widely. WordStar is flexible in adapting to a user's whims, so no matter how you like your eggs, you can without great technical

knowledge persuade WordStar to deliver them. Facilities are even provided to create and utilize files containing a set of patches that you can automatically call into your working WordStar copy. WordStar patch trading could become a frantic underground activity among users.

There are many finer details of Release 4 that I have not covered — I have to finish this article sooner or later — but I hope that this general review can give a good feel for the capabilities of the program. In conclusion, I might mention that Release 4 comes with drivers for various laser printers. Add that to the microjustification capabilities and the index and table of contents features, and you can produce your next professional-looking book or manual, in house, without the need for expensive desktop publishing packages. With a little manipulation of the macros and printer drivers, you may even be able to get multicolumn documents from WordStar.

ADDRESSES AND MORE INFORMATION

WordStar

Wordstar CP/M Edition, Release 4 carries a suggested retail price of \$295. But all CP/M users can order it directly from MicroPro for \$89 (plus \$5 for shipping). To order with a credit card call 1-800-227-5609. To order by mail, the address is:

MicroPro Sales Service
P.O. Box 7079
San Rafael, CA 94901-7079

Z-System

For more information on the Z-System and a catalog that describes their products, write or call:

Echelon, Inc.
885 N San Antonio Road
Los Altos, CA 94022
415-948-3820

Z280 S-100 Board

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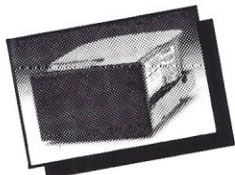
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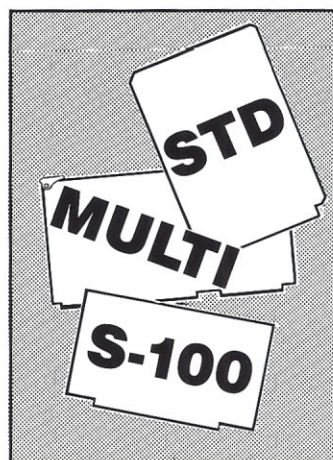
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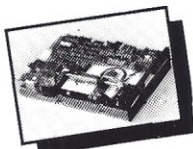


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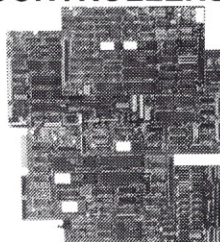


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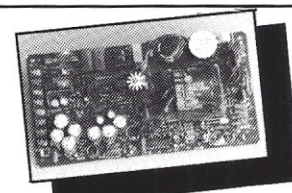
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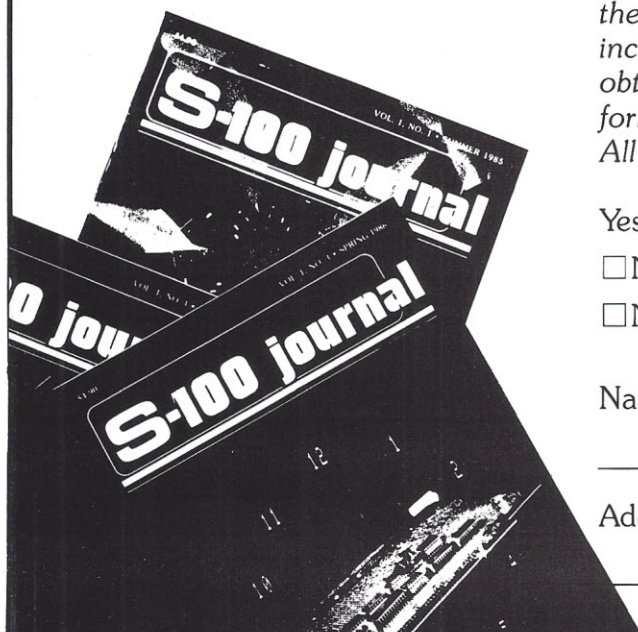
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Z sets you free!

Who we are

Echelon is a unique company, oriented exclusively toward your CP/M-compatible computer. Echelon offers top quality software at extremely low prices; customers are overwhelmed at the amount of software they receive when buying our products. For example, the Z-Com product comes with approximately 92 utility programs; and our TERM III communications package runs to a full megabyte of files. This is real value for your software dollar.

ZCPR 3.3

Echelon is famous for our operating systems products. ZCPR3, our CP/M enhancement, was written by a software professional who wanted to add features normally found in minicomputer and mainframe operating systems to his home computer. He succeeded wonderfully, and ZCPR3 has become the environment of choice for "power" CP/M-compatible users. Add the fine-tuning and enhancements of the now-available ZCPR 3.3 to the original ZCPR 3.0, and the result is truly flexible modern software technology, surpassing any disk operating system on the market today. Get our catalog for more information - there's four pages of discussion regarding ZCPR3, explaining the benefits available to you by using it.

Z-System

Z-System is Echelon's complete disk operating system, which includes ZCPR3 and ZRDOS. It is a complete 100% compatible replacement for CP/M 2.2. ZRDOS adds even more utility programs, and has the nice feature of no need to warm boot (^C) after changing a disk. Hard disk users can take advantage of ZRDOS "archive" status file handling to make incremental backup fast and easy. Because ZRDOS is written to take full advantage of the Z80, it executes faster than ordinary CP/M and can improve your system's performance by up to 10%.

Installing ZCPR3/Z-System

Echelon offers ZCPR3/Z-System in many different forms. For \$49 you get the complete source code to ZCPR3 and the installation files. However, this takes some experience with assembly language programming to get running, as you must perform the installation yourself.

For users who are not qualified in assembly language programming, Echelon offers our "auto-install" products. Z-Com is our 100% complete Z-System which even a monkey can install, because it installs itself. We offer a money-back guarantee if it doesn't install properly on your system. Z-Com includes many interesting utility programs, like UNERASE, MENU, VFILER, and much more.

Echelon also offers "bootable" disks for some CP/M computers, which require absolutely no installation, and are capable of reconfiguration to change ZCPR3's memory requirements. Bootable disks are available for Kaypro Z80 and Morrow MD3 computers.

Z80 Turbo Modula-2

We are proud to offer the finest high-level language programming environment available for CP/M-compatible machines. Our Turbo Modula-2 package was created by a famous language developer, and allows you to create your own programs using the latest technology in computer languages - Modula-2. This package includes full-screen editor, compiler, linker, menu shell, library manager, installation program, module library, the 552 page user's guide, and more. Everything needed to produce useful programs is included.

"Turbo Modula-2 is fast...[Sieve benchmark] runs almost three times as fast as the same program compiled by Turbo Pascal...Turbo Modula-2 is well documented...Turbo's librarian is excellent". - Micro Cornucopia #35

BGii (Backgrounder 2)

BGii adds a new dimension to your Z-System or CP/M 2.2 computer system by creating a "non-concurrent multitasking extension" to your operating system. This means that you can actually have two programs active in your machine, one or both "suspended", and one currently executing. You may then swap back and forth between tasks as you see fit. For example, you can suspend your telecommunications session with a remote computer to compose a message with your full-screen editor. Or suspend your spreadsheet to look up information in your database. This is very handy in an office environment, where constant interruption of your work is to be expected. It's a significant enhancement to Z-System and an enormous enhancement to CP/M.

BGii adds much more than this swap capability. There's a background print spooler, keyboard "macro key" generator, built-in calculator, screen dump, the capability of cutting and pasting text between programs, and a host of other features.

For best results, we recommend BGii be used only on systems with hard disk or RAMdisk.

JetFind

A string search utility is indispensable for people who have built up a large collection of documents. Think of how difficult it could be to find the document to "Mr. Smith" in your collection of 500 files. Unless you have a string search utility, the only option is to examine them manually, one by one.

JetFind is a powerful string search utility which works under any CP/M-compatible operating system. It can search for strings in

text files of all sorts - straight ASCII, WordStar, library (.LBR) file members, "squeezed" files, and "crunched" files. JetFind is very smart and very fast, faster than any other string searcher on the market or in the public domain (we know, we tested them).

Software Update Service

We were surprised when sales of our Software Update Service (SUS) subscriptions far exceeded expectations. SUS is intended for our customers who don't have easy access to our Z-Node network of remote access systems. At least nine times per year, we mail a disk of software collected from Z-Node Central to you. This covers non-proprietary programs and files discussed in our Z-NEWS newsletter. You can subscribe for one year, six months, or purchase individual SUS disks.

There's More

We couldn't fit all Echelon has to offer on a single page (you can see how small this typeface is already!). We haven't begun to talk about the many additional software packages and publications we offer. Send in the coupon below and just check the "Requesting Catalog" box for more information.

Item	Name	Price
1	ZCPR3 Core Installation Package	\$49.00 (3 disks)
2	ZCPR3 Utilities Package	\$89.00 (10 disks)
5	Z-Com (Auto-Install Complete Z-System)	\$119.00 (5 disks) *
6	Z-Com "Bare Minimum"	\$69.95 (1 disks)
10	BGii Backgrounder 2	\$75.00 (2 disks)
12	PUBLIC ZRDOS Plus (by itself)	\$59.50 (1 disk)
13	Kaypro Z-System Bootable Disk	\$69.95 (3 disks)
14	Morrow MD3 Z-System Bootable Disk	\$69.95 (2 disks)
16	QUICK-TASK Realtime Executive	\$249.00 (3 disks)
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21	ZDM Debugger for 8080/Z80/HD64180 CPU's	\$50.00 (1 disk)
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82	ZCPR3: The Libraries 310 pages	\$29.95
83	Z-NEWS Newsletter, 1 yr subscription	\$24.00
84	ZCPR3 and IOPs 50 pages	\$9.95
85	ZRDOS Programmer's Manual 35 pages	\$8.95
88	Z-System User's Guide 80 page tutorial	\$14.95

* Includes ZCPR3: The Manual



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MEET THE Z-SYSTEM

Robert A. Blum

Into The 80's is a column that debuts with this issue and was implemented by reader demand for more coverage of CP/M and Z-System. CP/M will obviously be covered, but the software coverage will most likely concentrate more on the modern-day CP/M replacement, the Z-System.

We also intent to use this column to discuss hardware technology based on Zilog 8-bit, 16-bit, and 32-bit chips, and their applications.

We would like to hear from readers what you would prefer to see in the column. Everything that is Zilog-compatible or related is fair game, including real-time applications and general real-world control done with the Z series of chips. If you have an application that you think will be of interest, please contact Bob Blum so he can share it here.

Bob will be our regular Into The 80's columnist. He has a long experience with CP/M-compatible hardware and software and has in the past written columns on related subjects for several national publications.

Please send all correspondence relative to this column to Robert A. Blum, c/o Supermicro, PO Box 1914, Orem, UT 84057.

CP/M reached its final level of maturity several years ago when its developer, Digital Research Inc. (DRI) decided to discontinue actively marketing it in the USA. As a consequence of a reduced revenue stream, DRI tried without success to entice several of the more prominent CP/M user groups to sustain CP/M support similar to that provided for public domain software. This seemed to be a reasonable request, except for DRI's reluctance to introduce the source code into the public domain. Indeed, attempting support of any product without having the proper tools is at best difficult if not impossible. As a result, no formal support is available any longer for CP/M.

With DRI's withdrawal, a willing OEM market for CP/M-compatible operating systems opened wide. What could have been a heated battle for market prominence by competing products was quickly settled in favor of the Z-System produced by Echelon, Inc. Their continued aggressive advertising and tireless marketing efforts have paid off (according to their figures) to the tune of 60K installed systems.

The Z-System began as ZCPR, a public domain CCP replacement program for CP/M. But through the diligent efforts of a few inspired individuals, it has evolved into its present-day form: a clean, polished, and complete 8-bit operating system. It retains full compatibility with its predecessor, but in all other ways far outstrips CP/M's capabilities. Moreover, it is actively supported by the publisher and by a group of independent computer users maintain-

ing BBS systems which offer the latest versions of system components and product news for the price of a phone call (see Table 1).

GETTING STARTED

If you are perfectly satisfied with your CP/M system, then there is probably no compelling reason to consider spending the time and money to switch to the Z-System. But if, on the other hand, you have become frustrated with CP/M's lack of powerful utilities and its general inflexibility, then it's time to look into a system that will not only satisfy your present needs but will in time be improved even further.

Before getting involved in the particulars of the Z-System, you should be aware that after installation your TPA (Transient Program Area) will be reduced by approximately 5K. If you are a heavy spreadsheet user or a system developer using memory-hungry programming tools, then you may want to consider the effect this loss of memory will have on your work before proceeding any further.

The Z-System is available in both automatic and manual installation versions. For the purposes of this discussion, I will limit my comments to Z-COM, the automatic installation package. In future columns, I will look at the manually installed version and the greater sphere of utility that it brings.

Z-COM is contained on five 8-inch disks: one disk contains the operating system components and the other four furnish the utilities and their associated help files. Printed

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8	Thomas Hill	Anchorage	AK	99504	
24	Barry Bowerman	Weaver	AL	36277	
22	Thomas Bowerman	Anniston	AL	36201	205-238-0012
52	Wells Brimhall	Phoenix	AZ	85028	602-966-8739
20	Richard Driscoll	Glendale	AZ	85301	602-939-6734
44	Robert Gear	Phoenix	AZ	85014	602-279-2762*
35	Norman L. Beeler	Sunnyvale	CA	94086	408-245-1420#
					408-735-0176#
34	Rod L. Blackman	Visalia	CA	93291	209-739-8303
63	Michael Breaux	Poway	CA	92064	619-486-0735*
54	Clinton Cook	Merced	CA	95348	209-383-6417
72	Harris B. Edelman	Venice	CA	90291	213-306-1172
21	Robert Finch	Glendale	CA	91205	
6	Andrew Hart	Palo Alto	CA	94306	415-493-4506
2	Al Hawley	Los Angeles	CA	90056	213-570-9465*
55	Brian King	Castle AFB	CA	95339	
57	Steve Kitahata	Gardena	CA	90247	213-532-3336
70	Jim Moyer	San Jose	CA	95129	
1	David McCord	Fremont	CA	94536	415-489-9005
36	Richard Mead	Pasadena	CA	91105	818-799-1632
18	John Rovner	Union City	CA	94587	
71	Byron Smith	Tulare	CA	93274	209-685-0306
75	Mel Spencer	San Diego	CA	92138	619-560-8929
25	Douglas Thom	San Jose	CA	95129	408-253-1309
19	Fred Townsend	San Jose	CA	95132	408-262-5150
9	Roger Warren	San Diego	CA	92109	619-270-3148
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28	Stanley London	Aurora	CO	80013	303-680-9825
53	Peter Glaskowsky	Miami	FL	33156	305-235-1645
27	Charlie Hoffman	Tampa	FL	33629	813-831-7276*
32	Allan E. Levy	Satellite Beach	FL	32927	
17	Robert B. Tate	Altamonte Springs	FL	32701	305-831-6049*
29	Edward C. Unrein	Altamonte Springs	FL	32701	305-774-2591*
51	Edward C. Unrein	Orlando	FL	32810	305-295-0844*#
46	Jim S. Altman	Atlanta	GA	30316	404-627-7127*
67	George Reeves	Decatur	GA	30030	404-378-3790
66	David Van Horn	Honolulu	HI	96814	808-527-8668
15	Richard Jacobson	Chicago	IL	60606	312-649-1730*
15	Richard Jacobson	Chicago	IL	60606	312-664-1730*
5	Ron Stone	Lisle	IL	60532	312-420-1722*
37	Marvin Eyre	Robards	KY	42452	502-521-7011
3	Jay P. Sage	Newton Centre	MA	02159	617-965-7259*
43	John D'Ausilio	Bladensburg	MD	20710	301-779-7986*
41	Larry Mansfield	Baltimore	MD	21214	301-254-6277
73	George Allen	Ballwin	MO	63021	314-394-6279*
61	Gregg Briton	Whiteman AFB	MO	65305	
30	Ben Ragan	St Louis	MO	63134	314-423-7038
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64	Edward Mecka	Hoboken	NJ	07030	201-798-0065
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26	Robert Kuhmann	Belle Etoile, par St. Martin de la Brasque	FRANCE	84760	11-33-90-77-60-15
69	R. C. Page	Waltham Abbey, Essex	ENGLAND	EN9 3EE	
62	Lindsay Allen	Perth, West Australia	AUSTRALIA	6153	61-9-364-9924
50	Mark Little	Alice Springs, NT	AUSTRALIA	5750	61-089-528-852

Table 1. Z-System BBS Support Network (Z-Nodes). Lack of RAS (Remote Access System) telephone number indicates that node may not be up. A "*" indicates node is a downloader of Echelon proprietary software; ask node SYSOP for procedure. A "#" indicates a multiuser RAS with two or more phone lines.

documentation comes in the form of several information sheets and a copy of Richard Conn's book, *ZCPR3 The Manual*. This book discusses the system's 90+ utility programs in detail. It also offers an in-depth comparison between CP/M and the Z-System, and it provides information on customizing your system, should that need arise. If your questions are still not answered, the on-line help facility can provide further data on both the internal and external commands and utility programs.

INSTALLATION

Installing Z-COM will probably not take more than a few short minutes once you have copied the distribution disks onto work disks. The installation process entails executing a single submit file and is greatly simplified if you have high-density disk drives capable of storing a little over 1 Megabyte. If so, the contents of all five distribution disks will fit on a single work disk and no disk swapping will be necessary, allowing the installation to take place non-stop. If your disk space is limited, the installation process includes extra manual steps: making several working disks, and individually installing the system on each. In either case, the steps are fairly well mapped out and shouldn't cause any undue problems.

Once complete, the installation process has created a file on the first disk that contains the complete Z-System (ZCPR3 and ZRDOS). To begin using it, simply run the command ZC.

Z-SYSTEM DIFFERENCES

So far I have not touched on any of the improvements incorporated into the Z-System. In lieu of an exhausting dissertation, I will treat each major feature of the system in detail in future columns. For now, please accept an overview of the operating system in general.

Depending on the disk capacity of your computer system, you probably change disks often enough to have been plagued by the dreaded error message that results from not hitting CONTROL-C after a disk change. The Z-System automatically senses this change for

you and logs in the new disk without any further manual intervention.

The most obvious difference that you will notice immediately is the drive prompt. It now contains not only the alpha drive descriptor but also the user area number followed by a directory-descriptor word (ROOT in the standard system). The named-directory facility allows you to assign a descriptor name to each user area. This name can then be used when switching between user areas on the same disk and in combination with the disk drive name when moving to another disk and user area. To get a firsthand impression for this feature, you may want to call one of the BBS systems from Table 1. All of these systems run the Z-System and are excellent support centers.

Another feature that will prove most beneficial if you typically handle many user areas is the search path active when opening a command file. As you know, in standard CP/M, a program operates properly only if the main phase and all of its overlay files reside in the currently logged-in user area. As a consequence, the program must be copied into all the user areas where its execution is required. This results in multiple copies of the same program needlessly taking up valuable disk space.

The Z-System alleviates this problem in two ways. First, a program will be successfully executed if it exists in any one of four default user areas. Or, even better, in the public version of ZRDOS (an extra cost option), files that must be common to all user areas can be grouped in a specific public user area and are thereby assigned global system status. Both executable and data files can reside in this public user area.

Another difference that I want to mention is compatibility between the standard CP/M CCP and ZCPR3. Except for the USER command, all the standard CP/M commands are still available and work as expected. The Z-System, however, offers more functionality in each command (see Table 2) plus some new and useful commands.

A major advantage of using an operating system that is actively being marketed is the set of support utilities and programs that are available and continually being

FUNCTION	Z-SYSTEM COMMAND	CP/M COMMAND
Display DIR file names	DIR DU:afn	DIR D:afn
Display SYS file names	DIR DU:afn S	none
Display all file names	DIR DU: afn A	none
Erase Specified Files	ERA DU:afn	ERA D:afn
with verification	ERA DU: afn V	none
Rename File	REN DU:ufn1=ufn2	REN D:ufn1=ufn2
Query if ufn1 exists	REN DU:ufn1=ufn2	none
Print File on Console		
Without Paging	TYPE DU: ufn	TYPE D:ufn
With Paging	TYPE DU: ufn P	none
List File on Printer	LIST DU:ufn	none
Save Memory into File		
Without Overwrite Warning	none	SAVE n D:ufn
With Overwrite Warning	SAVE n DU: ufn	none
With Overwrite Warning (hex blks)	SAVE nH DU:ufn	none
With Overwrite Warning (hex bytes)	SAVE nH DU:ufn S	none
Load File into Memory	GET adr DR:ufn	none
Reexecute Last Program	GO parameters	none
Call Subroutine in Memory	JUMP adr	none
Change Disk	D:	D:
Change User Area	U:	USER u
Change Disk and User	DU:	none
Prefix Commands	D:,U:,DU:,DIR:	D:

Table 2. Z-System and CP/M CCP Resident Command Cross Reference. (DU: - disk/user name. afn - group of directory files. ufn - a specific file name. adr - memory address or page.) Table adapted from "ZCPR3 The Manual."

added or updated. Besides the Z-System itself, Echelon offers assembly language programming tools (libraries of code modules, debuggers, disassembler, translators), Modula 2, communications program, keyboard key redefiner, print spooler, and many other programs and utilities.

The real power of the Z-System becomes even more obvious when its many customization features are examined in full detail, another subject for future columns.

In closing, if you have a special topic that you would like to discuss, please send me a note. Any column

is only as good as the satisfaction of its readers, so let me know what you wish to see here.

For more on the Z-System contact:

Echelon, Inc.
885 N. San Antonio Road
Los Altos, CA 94022
415-948-3820

A catalog of Z-System software is available from Echelon which explains in detail several features of the OS and utilities available.

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Macrotech MI-286 board. Used 3 months. In perfect condition (recently tested by Macrotech). \$375. Call or write L. H. Koopmans, 7400 Dellwood NE, Albuquerque, NM 87110. (505) 884-4645.

Rugged 10-slot commercial chassis with Z-80, dual 8-inch floppies, complete system. Extensive word processing, accounting, and commercial software. Must go — best offer received by 12/31/87. Send SASE for details. Winer Mobile Observatory, 10912 Broad Green Terrace, Potomac, Maryland 20854. (301) 983-9442 evenings.

Cromemco Z2H computer, 10 Megabyte hard disk & 2 5 1/2" floppy drives, Cromix multiuser operating system, 2 printers (dot matrix and letter quality), magnetic tape drive, all manuals included. Best Offer (692) 965-3000. Ecological Society of America.

CompuPro S-100 System: CPU 68K w/MMU, CPU 88/85, 640K RAM, Interfacer-3, Interfacer-4, SS1, Disk-1, 2 DS/DD 8" floppies, Disk-3, 52MB HD, also Lomas Megaram (unpopulated), Lomas LDP72 floppy controller (5"/8"), Wyse 50 terminal, Uniplus+ UNIX System V O/S, CP/M 80/86, MS-DOS, all manuals, working system. \$5000, 506-455-5654.

SDS Expandoram III 256K memory board, never used, in original carton. Provided with 64K, but easily expandable to full capacity with 4164 chips. CP/M RAM-disk software included: \$150. Contact Grace Rice (714) 993-2448.

Seattle Computer Gazzele 8086 8087 CPU's 128K memory. 300F parallel support 400B serial boards. Tarbell dual 8-inch DSDD 2-Megabyte discs. 18 slot S-100 chassis. DOS 2.0, Fortran, SIG software. Televideo 925. \$5.5K original price, low hours. Larry Dersh, 205 So. Francica St. No. 2, Redondo Beach, CA 90277. (213) 374-5643.

FOR SALE: 9 AMPEX D80/D81 Smart terminals. 6 known to work. 3 uncertain of. SURPLUS — need to liquidate NOW! MAKE ME AN OFFER — on one or all! Gordon Hesketh. (713) 471-4900.

MICROMATION S-100 complete 3-user system. 18 MB Fujitsu 8" hard disk, Qume 8" DS DD floppy. Each user has separate 64K 4MHz Z-80. MP/M operating system configured and ready to boot. Complete with all manuals, clean, low hours of use. \$500 firm plus shipping. Also, 3 Zenith Z-19 terminals available at \$150 each. Call Paul Pennington at 404-863-7285.

For Sale: Cromemco System 3; MC68000/Z80 DPU processor; 64 FDC floppy-disc controller; WDI-II hard-disk interface; 756K RAM; IOP processor; QDRT I/O; 20 MB hard disk, HD20; 8-inch Tandon TMS 48 floppy drive; C10 terminal; 68000 CROMIX, 68000 FORTRAN, PROCALL-communications sof-

ware. Manuals for all. Four years old, excellent condition. \$5700 or best offer. (415) 359-0569.

INTEGRAND S-100 mainframe with ITHACA Intersystems Z80 CPU. 4-8" drive DSDD controller, 2-parallel/2-RS-232 ports. Digital Research 64K static memory board. 2-Shugart 851 DSD disk drives (1.14MB ea.) Needs RS232 terminal and printer for a complete working system. Make offer for all or part. Charlie (607) 798-7111.

(2) **New** S-100 Mainframes by International Instrumentation Incorporated. 12-slot motherboards. S-100 Switcher power supply, with output for floppy or hard drives. Units come with desktop enclosures and rack-mount front panels with drive cutouts. Schematic documentation included. Units have never been used. \$400.00 for both. Contact: Ira Goodberg (213)650-6327.

CompuPro 816A, S-100, 88/85, 256K, 512K Mdrive, two 8" Qumes, Wyse 100, Hayes 300, Pascal MT+86, Aztec C86, Vedit 80/86, dBase, SuperCalc, 2000 hrs, MS-Basic 80, \$2000. Neil, 404-255-8007.

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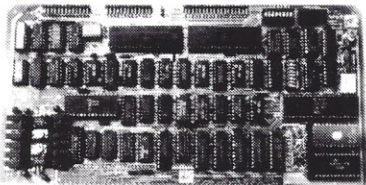
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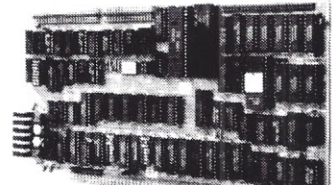


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COMDEX/Fall'87: A LOOK AT PERIPHERALS

Frederick D. Davis

This section substitutes the News and New Products for this issue only.

There usually aren't many S-100s at COMDEX, so we thought you might enjoy a look at some of the newer peripherals. Most of these can easily be connected to an S-100 system, although a few do require an OEM implementation.

The News and New Products will return in the next issue, then with products from VMEbus and Multibus in addition to S-100 products.

If your company has a product or news item that S-100, Multibus, or VME users and OEMs might be interested in, please be sure to send it along. Photographs, including color transparencies are welcome for publication. There is no charge whatsoever to publish information about your product in News and New Products but we do reserve the right to select what we think are the most significant items. S-100, VME, and Multibus products will have first priority for publication.

With more than 1400 displays, COMDEX/Fall '87 was physically overwhelming. It's like trying to watch a 1400-ring circus. Fortunately, I have been asked to report only on high-performance peripherals, otherwise I wouldn't know where to start.

At any COMDEX, there is always a variety of trends in peripherals. Printers, for example, continue to be improved. Twenty-four pin printheads appear to be the coming standard for all but economy and certain high speed printers. Print speeds exceeding 400 cps are getting reasonably routine at affordable prices. These same printers can turn out good NLQ printing at speeds around 100 cps. Color is a growing trend in printing. Many of the 24-pin printers also have color capability. A variety of color imaging and printing systems were shown.

Optical disk drives were a hot item. At the present, Write Once Read Many times (WORM) drives are all that is available. Optical read/write drives will probably become available next year. The WORM drives generally interface through a SCSI port. Direct support through your operating system or through device drivers is essential for utilizing these drives. The bulk of the drives are 5¼-inch with a few larger.

Magnetic hard disks are getting larger and faster. Only a few years ago a 5-Megabyte drive was normal, a 10-Megabyte large, and a 20-Megabyte was an extravagance. A 40-Megabyte drive was so huge that nobody could possibly use all of it. Access times of 85ms were normal and 65ms was ffaaast.

Now 40 Megabytes are becoming

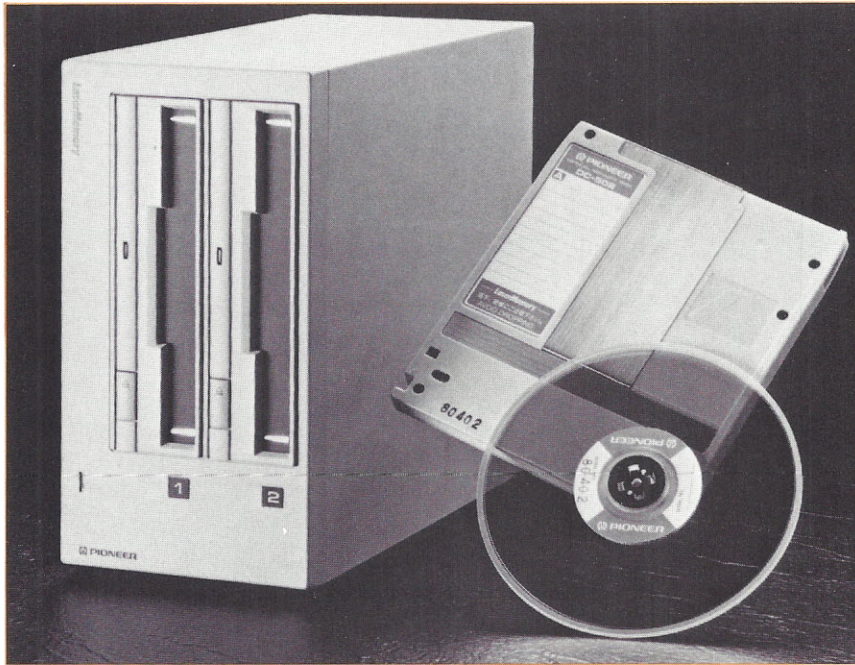
normal, 120 large, and 300 Megabytes or even 600 Megabytes are often desirable. Typical access times have fallen considerably. Times of 40ms are normal, 28ms is moderately fast, and now 16-18ms is really fast. Many of the larger faster drives use the SCSI or ESDI interfaces with faster data transfer rates.

Some trends are emerging in terminals. As multiuser microcomputer systems are on the increase, so are terminals for these systems. Higher frequency screen refresh (65 to 70 Hz) is a welcome sight. This removes that annoying flicker that is most apparent with large reverse video areas.

Many companies are now entering the PC-terminal market. This is actually of significance to S-100 users because the new versions of Concurrent DOS, for example, support PC terminals. Assuming that the Concurrent DOS OEMs on S-100 products don't remove this feature from CDOS, these terminals will be to our benefit in the near future, making it easier to run PC programs on the S-100.

WORMS

Optical drives being the sexy item of the year, many companies are offering a WORM drive and promise erasable or read/write drives for next year. Presently, if write-once capability is enough for your needs, then you are in luck. Availability of any specific unit may depend upon FCC approval. Sizes range from 5¼ to 14 inches from a variety of companies. Various jukebox arrangements for holding 20 to 50 disks giving a total capacity of up to 340 gigabytes or more are also



The Pioneer DD-S5001 optical drive stores 600 Megabytes per disk. The permanent data on the disk is estimated to last at least 15 years.

available in modest variety. Typical of the 5 1/4-inch units are the MAXTOR RXT-800S and PIONEER DD-S5001.

Both drives can only read or write on one side at a time. The disk cartridges can be written on both sides but the user has to flip them. They interface to the computer through a SCSI port. Having looked at a number of different drives, I see no present consensus on the best way to do things, so there is a great deal of variability in the specifications as each company makes different trade-offs. The technology is far from mature, so I would expect frequent changes and improvements over the next few years.

The MAXTOR unit is formatted for 400 Megabytes per side. The drive has a variable rotational speed (334-668 rpm) allowing it to maintain a constant linear velocity. Average seek time is 108ms with a maximum of 324ms. Average latency is 60ms. A lifetime greater than ten years is estimated for the data on a disk cartridge.

The PIONEER unit is formatted for 300 Megabytes per side. It runs at 1800 rpm with an average latency of 16.6ms and an average seek time of 60ms. Data lifetime on disk is estimated at greater than 15 years.

HARD DISK DRIVES

MAXTOR, in the past known for their large hard disks for microcomputers, once again has rolled out larger hard disks. This year the emphasis is on SCSI and ESDI interfaces. Since MAXTOR itself only sells to OEMs, they have no suggested list prices, but in many cases, hard disks could cost more than the base computer system.

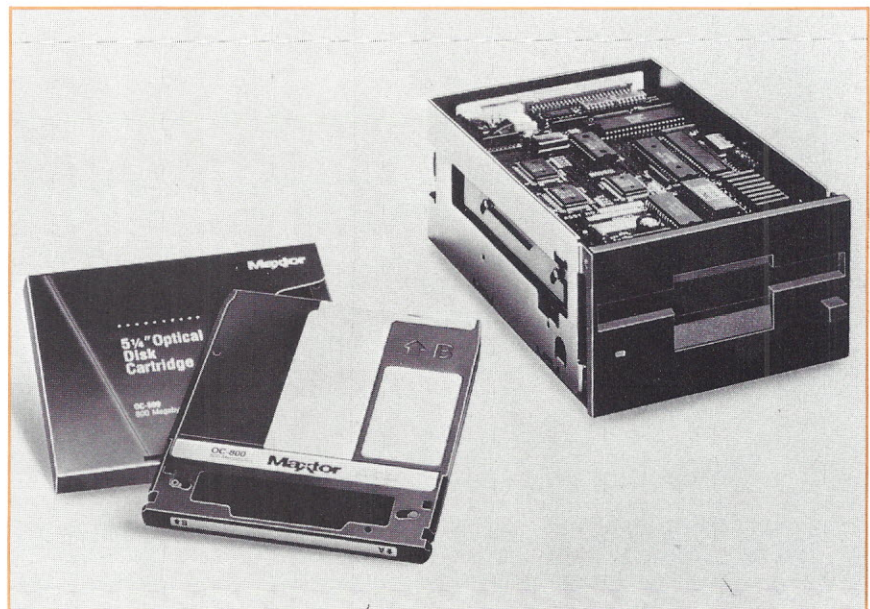
All of these disks have fast typical seek times, 16-18ms, and high transfer rates, 10 Megabits per second or higher depending upon the exact model and interface. Formatted capacities ranged from 158 to 667 Megabytes.

CONTROL DATA, another major player in hard disk, introduced several new product lines, Wren, Swift, and Sabre, all with fast seek times of less than 18ms. The new Swift line of 3 1/2-inch drives is available in unformatted capacities of 50, 150, and 200 Megabytes. The 200-Megabyte is available for ESDI, SCSI, and ST506 interfaces. The other sizes are ST506 only.

The Wren V 5 1/4-inch drives also come with versions for SCSI and ESDI controllers. The Sabre models are 8-inch hard disks available with a SCSI interface in capacities of 368, 500, 751, 851, and 1236 Megabytes. The transfer rates range from 14.5 to 24 Megabits/sec. Gangway for multigigabyte hard disk systems for microcomputers in the near future.

TERMINALS

Esprit (formerly Hazeltine) introduced the OPUS PCT4 (\$649) PC-terminal. It comes standard with an 84-key AT-style keyboard and with two pages of memory that can be upgraded to four pages. It has a

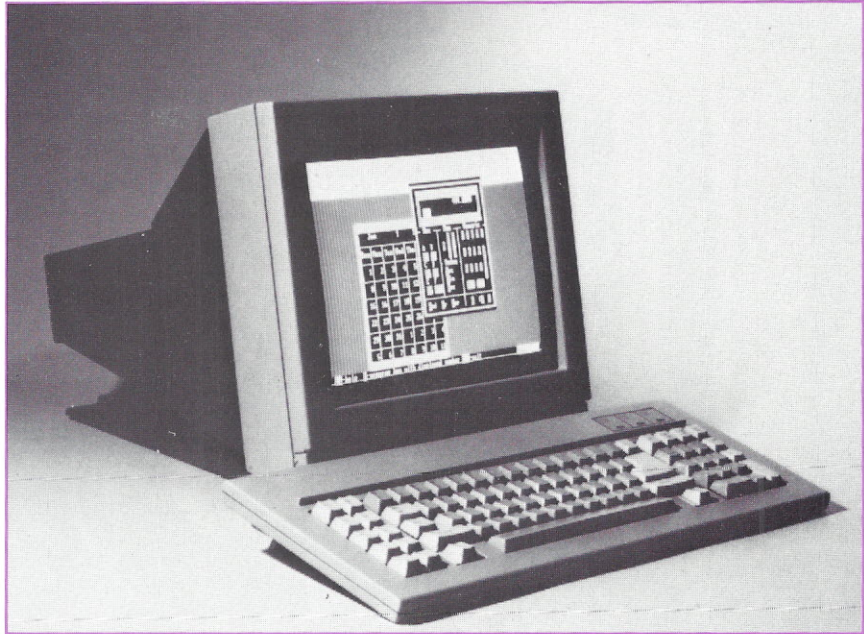


Maxtor's RXT-800S WORM drive stores 800 Megabytes per disk.

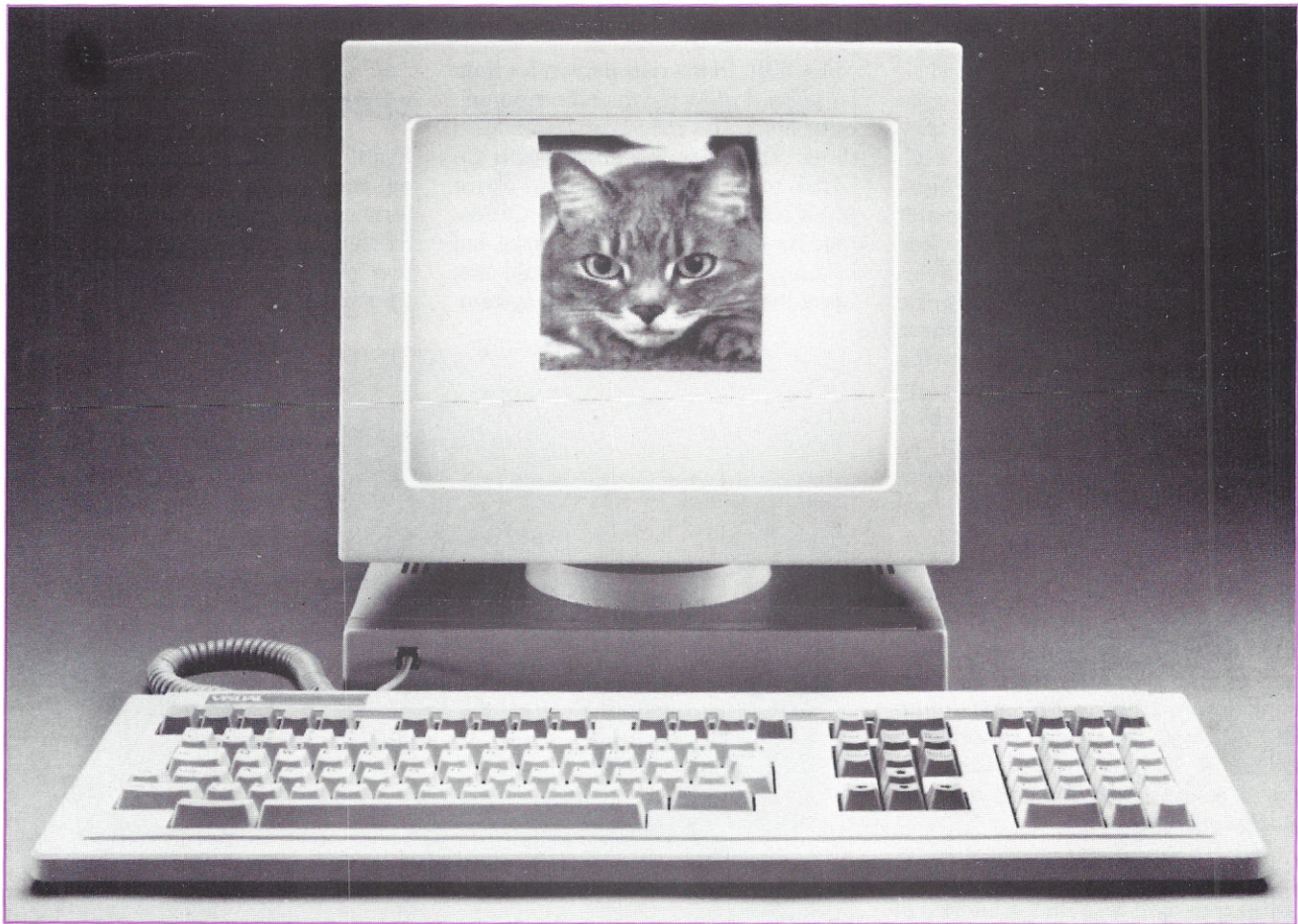
14-inch non-glare flat screen, high contrast CRT (green, amber, white), dynamic focus for sharper images, and eight emulations. Characters are 7×11 dot matrix with 2-dot descenders in a 9×13 dot field. 80 or 132 columns and 25 lines are supported.

The OPUS PCT4 has several unusual features. Foremost of these is the ability for the host computer to address the non-displayed screen memory, (alternative pages). This could be very useful with operating systems, such as Concurrent DOS, that support multiple virtual consoles.

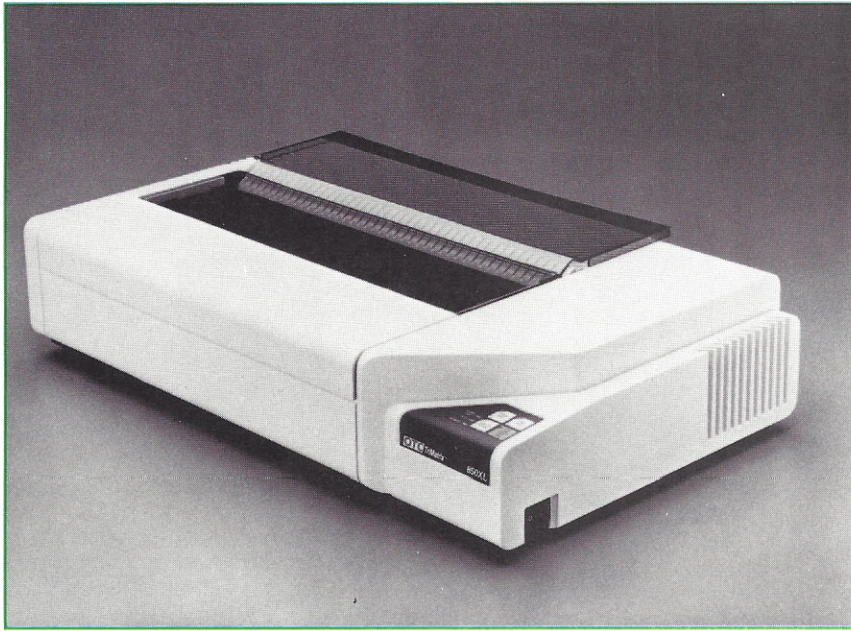
Another unusual feature of the PCT4 is that the AUX port can be used to connect to a second host system. This offers the capability of connecting the terminal to two entirely separate systems. Each port has its own non-volatile setup memory, so the terminal could look entirely different to each port. The PCT4 also contains a pop-up auto-dial program



The OPUS PCT4 from Esprit allows access to nondisplayed memory pages. Thus a second virtual console can be sent while another is being examined.



Visual's 600 line of "image display stations" offers high resolution graphics, and VT220 and Tektronix 4010/4014 compatibility. Newer features include local residency of programs on the local 512K memory with 68000 control.



The triple-headed OTC 850XL dot-matrix can print at up to 850 cps.

using Hayes-compatible commands. And it features a clock/alarm with reminder messages and three-month calendar. Current Loop interface and RS-422 interface are optionally available.

AMPEX is also throwing its hat into the PC-terminal arena with the introduction of the AMPEX 232 (\$499). The 232 is externally similar to the other AMPEX terminal models. It has a 14-inch flat non-glare screen (green, amber, white), dynamic focus for sharper letters, and choice of detached 84-key AT-style keyboard or 101-key RT ('enhanced') style keyboard. An important feature is a 65-Hz screen refresh frequency to eliminate visible flicker. Other features are nine resident national character sets, 9×12 dot field for each character, and 80 or 132 columns. Besides PC-terminal, only one other emulation is included, Televideo 925. The RS-232 serial interface is standard, Current Loop and RS-422 interfaces are optional.

The AMPEX 270 (\$569) is described as a full-featured ASCII terminal with high-resolution display. Physically it is almost identical to the AMPEX 232. The keyboard however is the same as the AMPEX 230, a well designed nonPC-style keyboard with sixteen programmable function keys. There are some important differences. Characters are 9×14 matrix with 3-dot descenders in a 10×16 dot

field. 80 or 132 columns and 24, 25, 42, and 43 lines are supported. The display is extraordinarily sharp. The screen has a 70-Hz non-interlaced refresh rate for an extremely flicker free display.

The 270 has nine resident national character sets, fifteen line graphic characters, downloadable soft character font, subscripts, superscripts, italic, strike-through, double-size characters, and proportional

spacing. Four pages of display memory are standard. It has eight speeds of smooth scroll as well as jump scroll. The 270 has ten resident terminal emulations. Interfacing is through an RS-232C serial port at baud rates up to 38.4K. It may also be configured as an RS-423 DTE port. The fully-buffered AUX port is also either an RS-232C or an RS-423 DCE. Optionally, a parallel printer port may be substituted for the auxiliary serial port.

VISUAL was at COMDEX with several new terminals and more to follow. The 601, 604, and 630 are termed 'integrated image display stations' by VISUAL. The 601 (\$695) provides WYSE 50+, Televideo 910/920/925, ADDS Viewpoint, and Hazeltine 1500 emulations, plus an enhanced Tektronix 4010/4014 emulation with local primitive processing. The emulations are contained in an easily replaceable cartridge allowing for different emulations in the future.

The 601 directly supports a number of peripheral devices including printers, bit pads, mice, and a plotter. The interface to the computer is an async serial RS-422/423/232 at up to 38400 baud. The standard display mode is dark letters/graphics on a bezel-to-bezel white background without edge distortion. On the



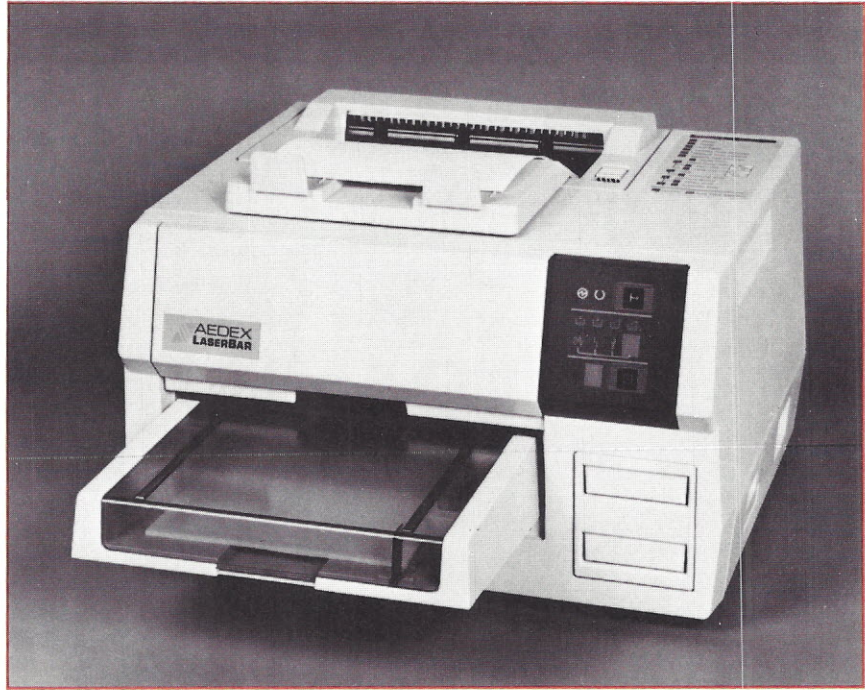
Okidata's Microline 393 has four speed/quality modes and plug-in fonts.

14-inch screen, characters are displayed in 25 lines by 80/132 columns or 50 lines by 132 columns. In 80-column mode, characters are an 11×14 matrix in a 13×16 cell. In 132-column mode, characters are a 6×14 matrix in an 8×14 cell. The display is a non-interlaced bit-mapped raster scan with a resolution of 1056×400. A 70-Hz screen refresh rate removes perceptual flicker.

Graphics and text may be displayed at the same time in the same plane of memory. The 601 has two graphics pages of memory, allowing one page to be displayed at the same time as another is being downloaded. It also has several 'Desk Top Accessories': an alarm clock, a calendar, and a calculator. The 604 (\$625) is identical to the 601 except that it has PC-terminal emulation and Hercules-compatible graphics with choice of AT or RT style keyboards. It has got to be the sharpest PC-terminal around. Personality modules, if you should need to change, cost \$50.

The VISUAL 630 (\$995) has all the features of the 601 with several exceptions and a few additions. The emulations include DEC VT220, VT100, VT52, and the enhanced Tektronix 4010/4014 instead of the emulations in the 601. There is a selectable interlaced scan mode with 1056×800 resolution and a 35-Hz refresh rate. This terminal also includes a VISUAL mouse and RS-232 interfacing capability.

The biggest difference is the inclusion of 512K (2 Megabytes optional) of RAM that can be divided as 256K for an application and 256K as a RAM-disk. Files are transferred to the RAM-disk using the X-Modem protocol. The memory can also be allocated as pages of alphanumeric or graphics memory. The on-board 12-MHz 68000 can execute local programs, and custom local processes can communicate with the host over the serial interface. A C-language toolkit (\$1500), not including compiler, is available for the development of those programs. The 630 also contains an editor, VISUAL WRITE, with up to 80 alphanumeric pages capacity.



The AEDEX Laserbar is specifically designed to print barcodes.

PRINTERS

Okidata demonstrated the new Microline 393 24-pin printer with four grades of printing quality: high speed draft (450 cps), utility (360 cps), near letter quality (180 cps), and letter quality (120 cps). The basic printer has a suggested list price of \$1399 (\$1499 for color) which includes the built-in font and push tractor. There is also an optional pull tractor for bottom feeding (\$79). A one-bin (\$399) and two-bin (\$699) sheet feeders are available. The 393 has a touch control front panel for setting fonts, letter spacing, etc. The printer accepts two font cartridges simultaneously (\$49 each). You may also download fonts. It comes with both a Centronics parallel and RS-232 serial interfaces.

Okidata also displayed the 182 Plus (\$319), a 30%-faster version of the 9-pin 182. The 182 Plus has front-panel mode and pitch selection, parallel or serial interface, and bottom or back paper feed.

Output Technology Corporation presented the latest version of a triple-headed 9-pin dot-matrix printer, the 850XL. The heads divide the 14-inch width by three with each head handling 1/3 of the width. The 850XL comes with Centronics and RS-232

interfaces. A standard 8K buffer is expandable to 256K. The standard version of the 850XL costs \$2395. Another version, the 850 PrintNet, allows connecting the printer to five computers at up to 19,200 baud. This last version has a standard 256K buffer. The OTC 850 printers emulate Epson, IBM ProPrinter XL, and DEC LA 120.

These printers feature burst speeds of 850 characters per second and throughput of 544 cps with modest speed printheads. The OTC 850 is this efficient only on 14-inch wide printing. With 8-inch printing, only one print head is fully used, defeating the point of having three heads. The printout on the demonstration units looked perfect, with no perceptible difference between the output of each printhead. However, when a printhead needs replacement, it must be done by a qualified service technician. The exact alignment of each head is critical to maintain printing homogeneity.

This printer also has the ability to produce five varieties of bar code in several sizes. The internal firmware that controls this feature is easily accessed through ASCII sequences from a program. The printer produces bar codes in graphics mode at the rate of six vertical inches per minute.

And specifically designed for bar

code printing, there is the AEDEX LaserBar-608, a laser printer based on the 300-dpi Ricoh engine. It prints bar codes on a variety of materials, easily handling heavy stock and adhesive labels. It also performs as a regular laser printer with emulations of Epson FX-80, Diablo-630, HP Laserjet+, NEC Spinwriter, Qume Sprint-11, and ANSI X3.64.

Because of its resolution, the LaserBar prints very sharp and solid bar codes. Eleven varieties of bar codes in a multitude of sizes can be produced under control of the LaserBar programming language. Graphics and bar codes are printed at the same speed as alphanumerics, 20 seconds for the first copy, 7.5 seconds per copy thereafter.

The LaserBar has 12 resident and 14 downloadable fonts. Graphics can be downloaded. The printer can be ordered with either an RS-232 serial (9600 baud maximum) or Centronics parallel interface. The duty cycle is 3,000 to 10,000 pages per month. The suggested retail price is \$4995.

One very unusual printer is from Riso Kogaku Corporation. To the computer, it looks like a laser printer with 400-dpi resolution. However, it makes a master from the electronic transfer and then can print 120 copies per minute at about 1/3 cent per copy. With multiple passes, it can print up to five colors. But this printer is not quite ready for purchase; the company is looking for an OEM to bring out a line of computer interfaces and software for it.

OTHER PERIPHERALS OF INTEREST

My choice for the slickest item at COMDEX is a new floppy disk. Kodak, under the Verbatim label, has introduced a Teflon-coated floppy disk that can be cleaned with little or no data loss after food spills, greasy fingerprints, typing correction fluid, and the like. Most contaminations simply wipe off the recording surface without data loss. The diskettes, under the name Verbatim Data-LifePlus, also have an antistatic envelope lining. The data retention is 65% to 94% better than non-Teflon floppies, according to their tests. Wearability tests indicate a disk life

exceeding 100 years of normal usage. At this time, only 5 1/4 DSDD preformatted disks are available.

Multi-Tech Systems, Inc. introduced several new modems. The MultiModem 696 (\$1295) is a new 9600-bps, asynchronous, full-duplex, dial-up desktop modem. Like their MultiModem 224E, the 696 uses standard MNP error correction. Because of the use of MNP instead of a proprietary method, it has the potential of being able to communicate with modems from other manufacturers as they bring out 9600 bps models having MNP. Unlike many other 9600-bps modems, the 696 also supports 2400, 1200, and 300 bps.

Multi-Tech also introduced the MultiMux 16 (\$2995), a 16-channel

statistical multiplexer with optional 9600-bps (\$1100) or 14,400-bps (\$2000) internal modems.

AEDEX has a line of RS-232 bar code decoders. All allow the device to be daisy chained with a terminal. The input to the program can come interchangeably from the keyboard or the decoder. The BCD-200 (\$550) can accept either a moving beam laser scanner (\$795) or bar code wand (\$145). It can identify and decode the eight most popular bar codes. The BCD-100 (\$400) decodes five bar codes and accepts input from any of several wands (\$145). The MSR-150 (\$695) decodes magnetic stripes and bar codes with addition of a wand (\$145). The MSR-50 (\$395) decodes magnetic stripes only.

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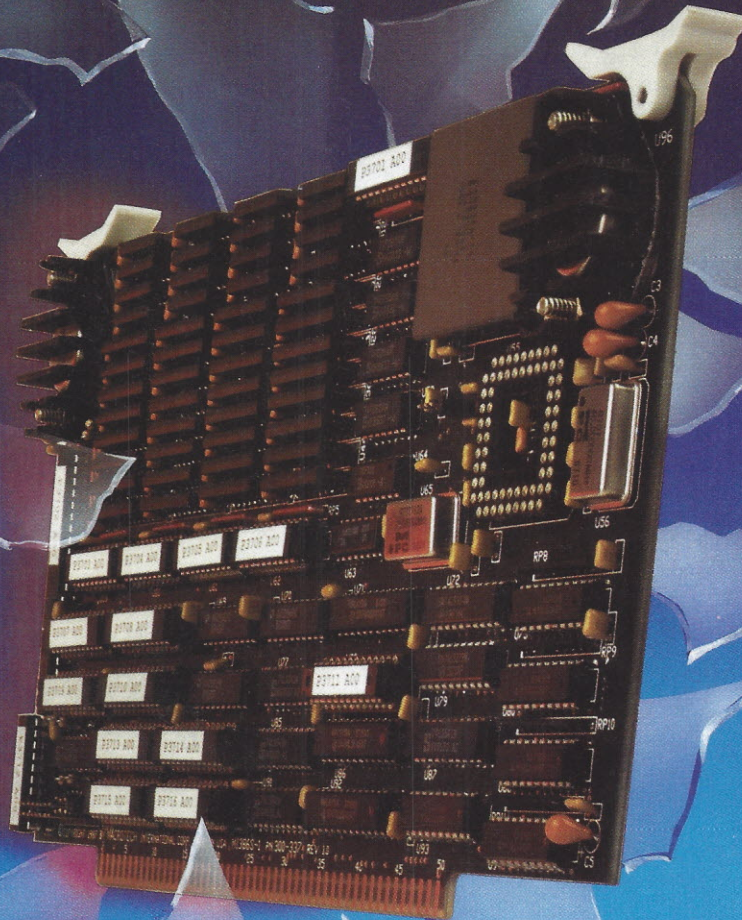
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